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Nr. 6. Aage J. C. Jensen: AN INVESTIGATION OF THE STOCK OF PLAICE IN THE SOUTHERN HORNS REEF AREA IN THE YEARS 1925 AND 1927.

KØBENHAVN
C. A. REITZELS FORLAG
BIANCO LUNOS BOGTRYKKERI
1928

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AN INVESTIGATION OF THE STOCK OF PLAICE IN THE SOUTHERN HORNS REEF AREA IN THE YEARS 1925 AND 1927

BY

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KØBENHAVN
C. A. REITZELS FORLAG
BIANCO LUNOS BOGTRYKKERI
1928

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I. Introduction.

a) Area investigated.

In the spring and autumn of 1925 and the spring of 1927, a number of fishing experiments were carried out from the S./S. "Dana" with a 50 ft. otter trawl in the southern Horns Reef Area.

This region is bounded on the north by Horns Reef and 55° 33′ N. Lat., which intersects the westernmost point of the Reef, on the south by 55° 00′ N. Lat., and on the west by 6° 00′ E. Long. The fishing experiments were too few in number for a quantitative or qualitative determination of the stock between the coast and a depth of 10 metres, and this investigation deals accordingly for the most part with the stations lying outside the 10 metre line. Fishing experiments carried out in Slugen, a channel up to 26 metres in depth through the eastern part of Horns Reef, gave results which, by reason of the special features as to depth and bottom, diverged appreciably from those given by the other fishing experiments and are irrelevant to the rest of the material.

b) The extent and nature of the material.

In 1925 from the 2nd to the 4th of April, fishing experiments with trawl were carried out south of Horns Reef at 10 stations and from the 14th to the 20th of October at 18 stations. Of the spring stations one was situated in Slugen, and of the autumn stations there was one station where the depth was less than 10 metres.

From the 28th to the 30th of March 1927 fishing experiments with trawl were carried out in the southern Horns Reef Area at 8 stations, of which one was situated in Slugen.

Material from previous years for the purpose of comparison is available notably from the autumn of 1922, when fishing experiments with trawl were carried out in the southern Horns Reef Area from the 13th to the 26th of September at 23 stations. Of the latter, one was situated in Slugen and one within the 10 metre line.

Further material for purposes of comparison is to hand in the fishing experiments with trawl carried out in the spring of 1907 (April 27th to May 7th) (15 stations in the southern Horns Reef Area outside the 10 metre line and Slugen) and a few fishing experiments with trawl from the springs of 1903 (April 10th), 1904 (Feb. 22nd—25th), and 1905 (April 15th) and from the autums of 1903 (Sep. 26th—27th) and 1904 (Sep. 27th—30th).

c) Previous investigations.

An investigation on the change in the stock during the war and subsequent to it up to June 1919, by A. C. Johansen and Kirstine Smith, based on the commercial catches of plaice landed at Esbjerg, was published in 1919[1]; this investigation was continued by Kirstine Smith in 1921[2], for the period

[1] A. C. Johansen and Kirstine Smith: Investigations as to the effect of the restriction of fishing during the war on the plaice of the eastern North Sea. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. V. No. 9. 1919.

[2] Kirstine Smith: Danish Investigations of Plaice from the North Sea July 1919—July 1920. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. VI. No. 2. 1921.

July 1919 to July 1920. The material from 1922 was dealt with in a paper by KIRSTINE SMITH in 1923[1] and compared with material from previous years. As regards the years prior to the war A. C. JOHANSEN has published a long series of investigations on the stock of plaice in the Horns Reef Area and its relation to the stock in the rest of the North Sea. In particular may be mentioned *Contributions to the Biology of the Plaice I, II, III, VI* and *VII.* Medd. f. Komm. f. Havunders. Ser. Fiskeri 1905—1915, as also *Bericht über die dänischen Untersuchungen über die Schollenfischerei und den Schollenbestand in der östlichen Nordsee, dem Skagerak und dem nördlichen Kattegat.* Medd. f. Komm. f. Havunders. Ser. Fiskeri, Bd. III. No. 8. 1910.

It is of special interest on the basis of the new material from 1925 and 1927 to investigate the latest phases in the changes in the stock of plaice in the North Sea after the partial protection afforded them by the war.

Since the material from the fishing experiments was collected partly in the spring and partly in the autumn, it will be necessary, for the purpose of instituting comparisons with the fishing experiments of the various years, to undertake

a comparison between the distribution and number of individuals of the stock in spring and in autumn within the southern Horns Reef Area outside the 10 metre line. For this investigation we possess from 1925 for the first time excellent material from this area. Only for the years 1903 and 1904 is earlier material available for comparing the stock in one spring with that in the following autumn; it is, however, of far less value.

The investigation covers moreover the following:

Fluctuations in the numbers and the distribution of the total stock.

The relative frequencies of the different year classes.

Growth.

The relative frequencies of males and females.

On the basis of the results of this investigation, will be given a survey of

the change in the stock after the partial protection of the stock of plaice in the North Sea afforded by the war.

II. Comparison between the spring and the autumn stock as regards number and distribution.

The result of the fishing experiments in 1925 is shown on the charts, Figs. 1 and 2, referring to spring of 1925 and 3 and 4, referring to autumn of 1925. Figs. 1 and 3 show the results classified according to length groups and Figs. 2 and 4 according to age groups.

The distributions at these two seasons is characteristic for them and is known from earlier investigations[2]. In the spring the main body of the stock is to be found in comparatively shallow water whereas in the summer it is distributed over a fairly large area. During the spring fishing experiments in 1925 (April 2nd—4th) only one plaice was caught at the three outer stations situated outside the 20 metre line. In the autumn of 1925 (October 14th—20th) on the other hand, a considerable part of the plaice stock was found outside the 20 metre line, and this was the case both as regards the younger and the older age groups, although particularly as regards the older. It should be mentioned that the variations

[1] KIRSTINE SMITH: On the Plaice Population of the Horns Reef Area in the Autumn of 1922. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. VII. No. 4. 1923.

[2] See A. C. JOHANSEN: Contributions to the Biology of the Plaice I. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. I. No. 2. 1905. p. 25.

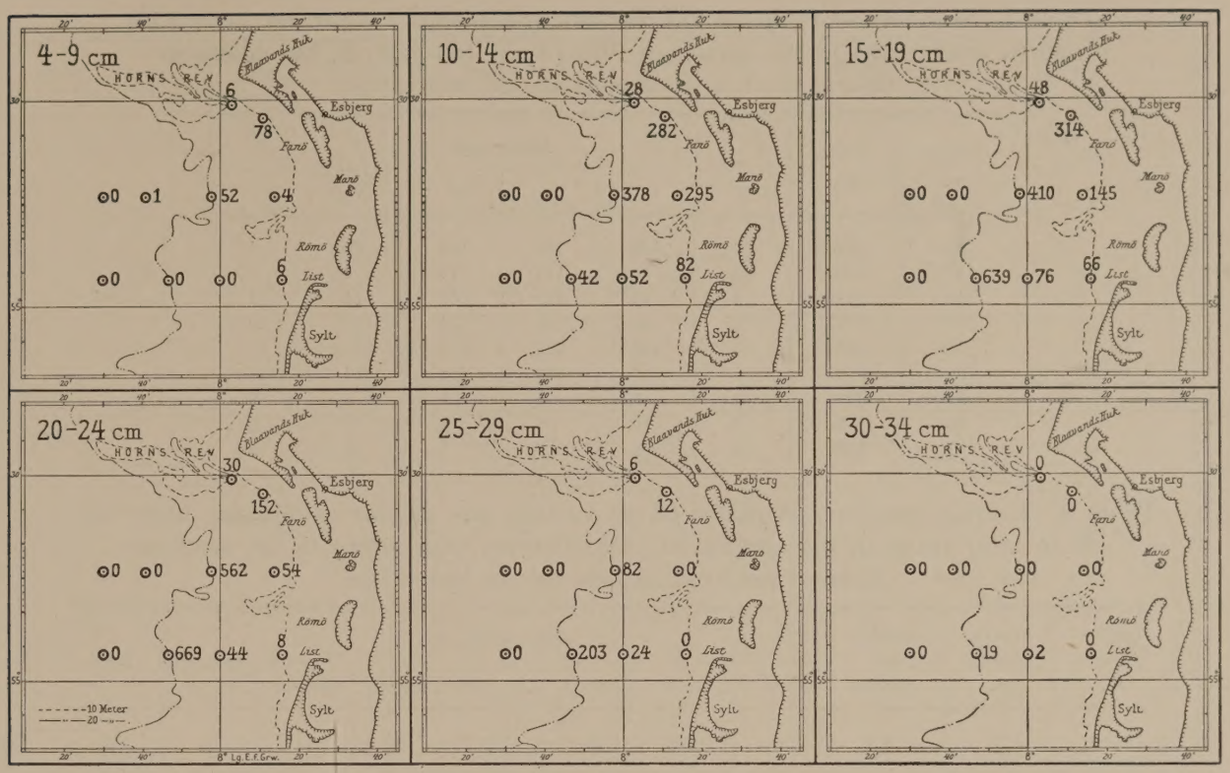


Fig. 1 Showing number of plaice of the different size groups caught per hour from s./s. "Dana" by a 50 ft. otter trawl with extra cod-end. — April 1925.

in number from station to station were about the same in spring as in autumn. Since the number of stations was considerably smaller in the spring than in the autumn investigations, the latter are of the greater value for a quantitative and qualitative investigation of the stock.

In the Tables 1, 2, and 3, 4, the results of the fishing experiments in the spring and autumn respectively of 1925 are given in a tabular form; the material collected in the autumn is arranged according to

Table 1. Numbers of plaice of the various size groups together with the total numbers caught per hour with 50 ft. otter trawl in the spring of 1925 (April 2nd—4th) in the southern Horns Reef Area outside the 10 metre line.

Depth m.	Stat. No.	Size groups, cm.						Total
		5—8	10—14	15—19	20—24	25—29	30—34	
10	3328	78	282	314	152	12	0	838
12	3320	6	82	66	8	0	0	162
13	3319	4	295	145	54	0	0	498
16	3321	0	52	76	44	24	2	198
18	3323	52	378	410	562	82	0	1484
20	3322	0	42	639	669	203	19	1572
24	3325	0	0	0	0	0	0	0
25	3324	1	0	0	0	0	0	1
27	3326	0	0	0	0	0	0	0

Table 2. Numbers of plaice of the various age groups caught per hour with 50 ft. otter trawl in the spring of 1925 (April 2th—4th) in the southern Horns Reef Area outside the 10 metre line.

Depth m.	Stat. No.	Age groups					
		I	II	III	IV	V	VI
10	3328	80	198	406	108	38	4
12	3220	0	30	118	10	4	0
13	3319	1	84	343	46	14	1
16	3321	0	26	88	34	28	22
18	3323	60	250	502	318	332	20
20	3322	0	55	668	366	347	128
24	3325	0	0	0	0	0	0
25	3324	1	0	0	0	0	0
27	3326	0	0	0	0	0	0

Table 3. Average numbers of plaice of the various size groups caught per hour with 50 ft. otter trawl in the autumn of 1925 (October 14th—20th) in the southern Horns Reef Area outside the 10 metre line.

Depth-zone m.	Average depth m.	Number of stations	Size groups, cm.							Total
			0—4	5—9	10—14	15—19	20—24	25—29	30—34	
10—19	15	5	0	82	66	155	59	11	1	373
20—29	25	5	0	16	58	385	170	85	8	722
30—39	32	4	0	0	0	110	187	68	6	372
> 40	49	3	0	0	0	0	11	33	6	49

Table 4. Average numbers of plaice of the various age groups caught per hour with 50 ft. otter trawl in the autumn of 1925 (October 14th—20th) in the southern Horns Reef Area outside the 10 metre line.

Depth-zone m.	Average depth m.	Number of stations	Age groups							
			0	I	II	III	IV	V	VI	VII
10—19	15	5	81	64	93	112	13	9	1	0
20—29	25	5	17	36	233	313	60	57	7	0
30—39	32	4	0	1	47	199	70	48	4	0
> 40	49	3	0	0	2	18	13	16	2	0

depth zones 10—19, 20—29, 30—39, and over 40 metres. In the Tables 1 and 3 the material is arranged according to size groups and in Tables 2 and 4 according to age groups.

It will be seen from the tables and charts, due regard being taken to the greater dispersion in the autumn, that particularly for the younger age groups there is a great difference in the numbers of the stock in spring and in autumn, the number for the total area investigated being much higher in the autumn than in the spring fishing experiments. The fact that fewer plaice are found by fishing experiments in the spring than in the autumn has been proved by other authors[1].

[1] See A. C. Johansen: Contributions to the Biology of the Plaice. II. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. II. No. 5. 1907. See also: Die Beteiligung Deutschlands an der internat. Meeresf. IV/V Jahresber. 1909.

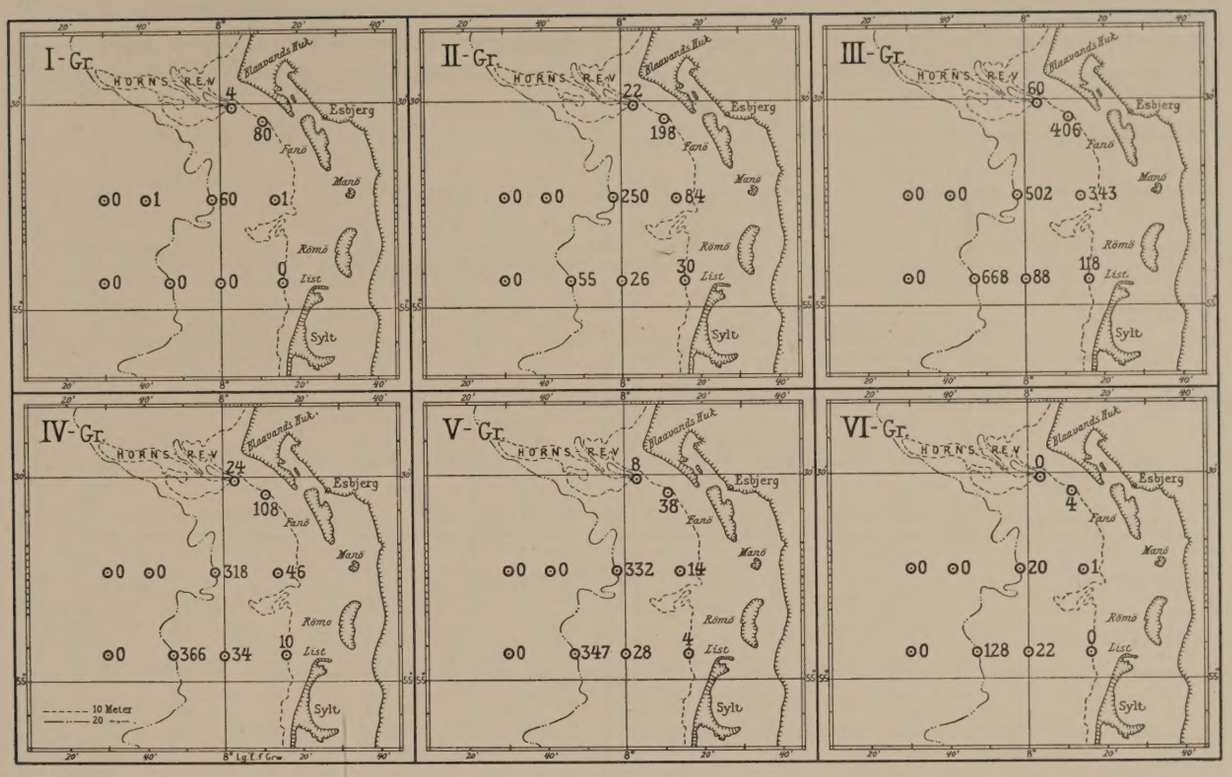


Fig. 2. Showing number of plaice of the different age groups caught per hour from s./s. "Dana" by a 50 ft. otter trawl with extra cod-end. — April 1925.

It is however, by reason of the great difference in the dispersion of the plaice throughout the area in the spring and autumn, impossible to institute a direct comparison of an even approximately satisfactory character. The stock from the two seasons must therefore first be reduced to the same area, before we can find the relation between the numbers of the stock at the two seasons.

Only a very few plaice were found at the spring fishing experiments at greater depths than 20 metres, and therefore we may reasonably take the number found in the area of depth-zone 10—19 metres as the starting point for a calculation of the relative frequencies of the plaice stock in the spring and autumn in the southern Horns Reef Area outside the 10 metre line. We will therefore also for the autumn stock calculate the catch per hour, regarding the stock of plaice as concentrated within the area of the depth-zone 10—19 metres.

If each of the 6 stations, which in the spring of 1925 were situated in this area between the 10 and the 20 metre line, is assumed to represent one sixth of the area, the average catch for the 6 stations will give us the average number of plaice caught per hour.

As regards the autumn stock, Table 4 gives the mean numbers, calculated in a corresponding manner, of the plaice caught per hour for each of the various depth-zones. The mean numbers of plaice caught per hour, when the stock is regarded as being collected in the depth-zone 10—19 metres, are found by addition, after the mean number of plaice caught per hour in the outer depth-zones has been multiplied by the proportion between the area of the depth-zones in question and the area of the depth-zone 10—19 metres.

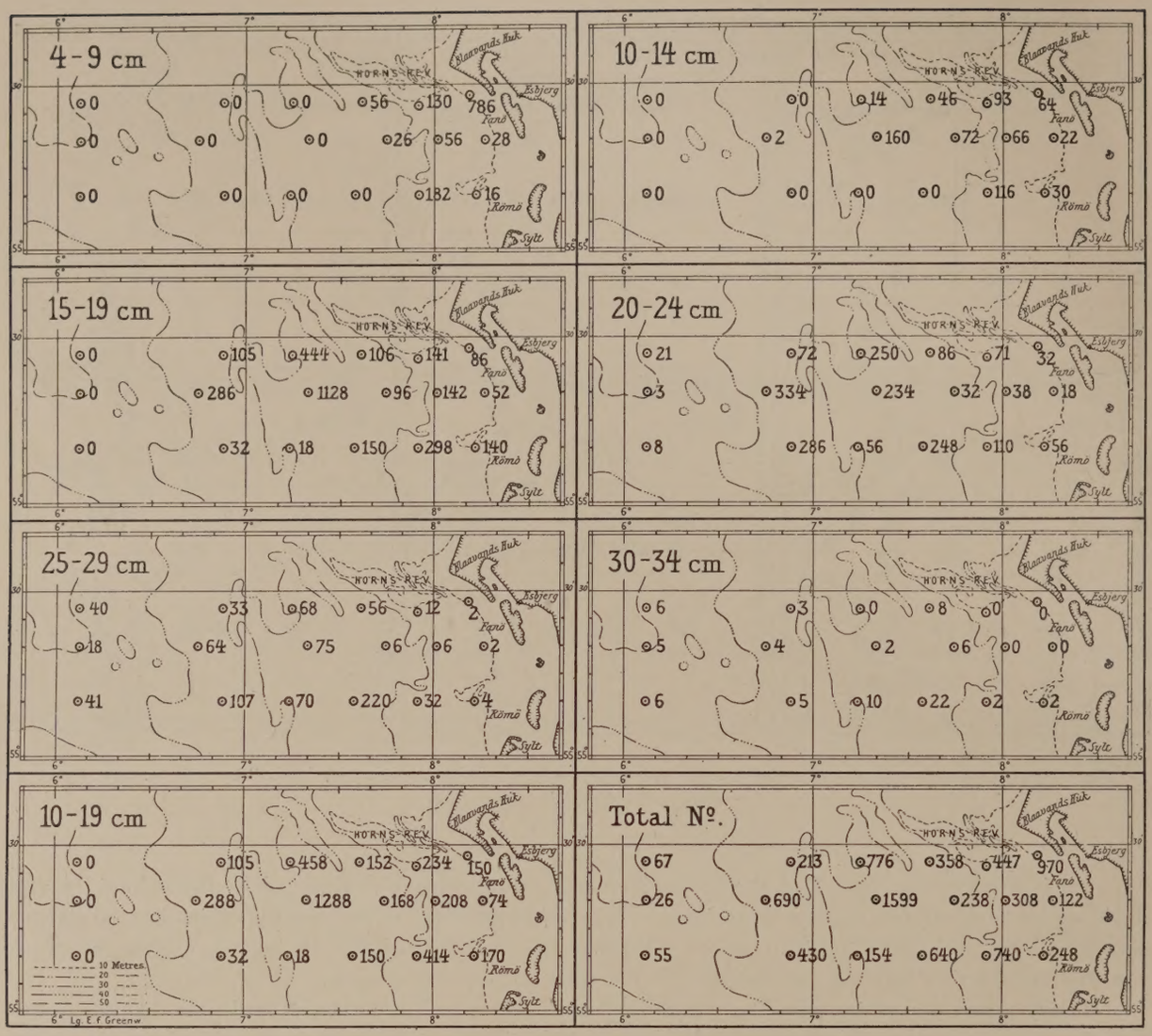


Fig. 3. Showing number of plaice of the different size groups and total number caught per hour from s./s. "Dana" by a 50 ft. otter trawl with extra cod-end. — October 1925.

The areas were found by planimeter to be of the following sizes:

Zone 10—19 m.	.....	456	square miles
— 20—29 -	.....	871	— —
— 30—39 -	.....	542	— —
— > 40 -	.....	678	— —

The proportion between the areas of the different zones from the 10 metre line outwards can therefore be taken as $1 : 2 : 1 : 1^1/_2$.

We have then in the following table the relative values for the numbers of the various age groups and for the totals in the southern Horns Reef Area outside the 10 metre line, calculated from the fishing experiments in the spring and autumn of 1925.

Table 5. Comparison between the numbers of plaice of the different age groups caught per hour in the area between the 10 and 20 metre line (the autumn stock being calculated as concentrated within this area) in the southern Horns Reef Area outside the 10 metre line in the spring and autumn of 1925.

	0	I	II	III	IV	V	VI	VII	Total
Spring 1925	0	23	107	354	147	127	29	0	792
Autumn 1925	115	137	609	964	223	195	22	0	2262
Proportion between numbers in spring & autumn 1925	—	6.0	5.7	2.7	1.5	1.5	0.8	—	2.9

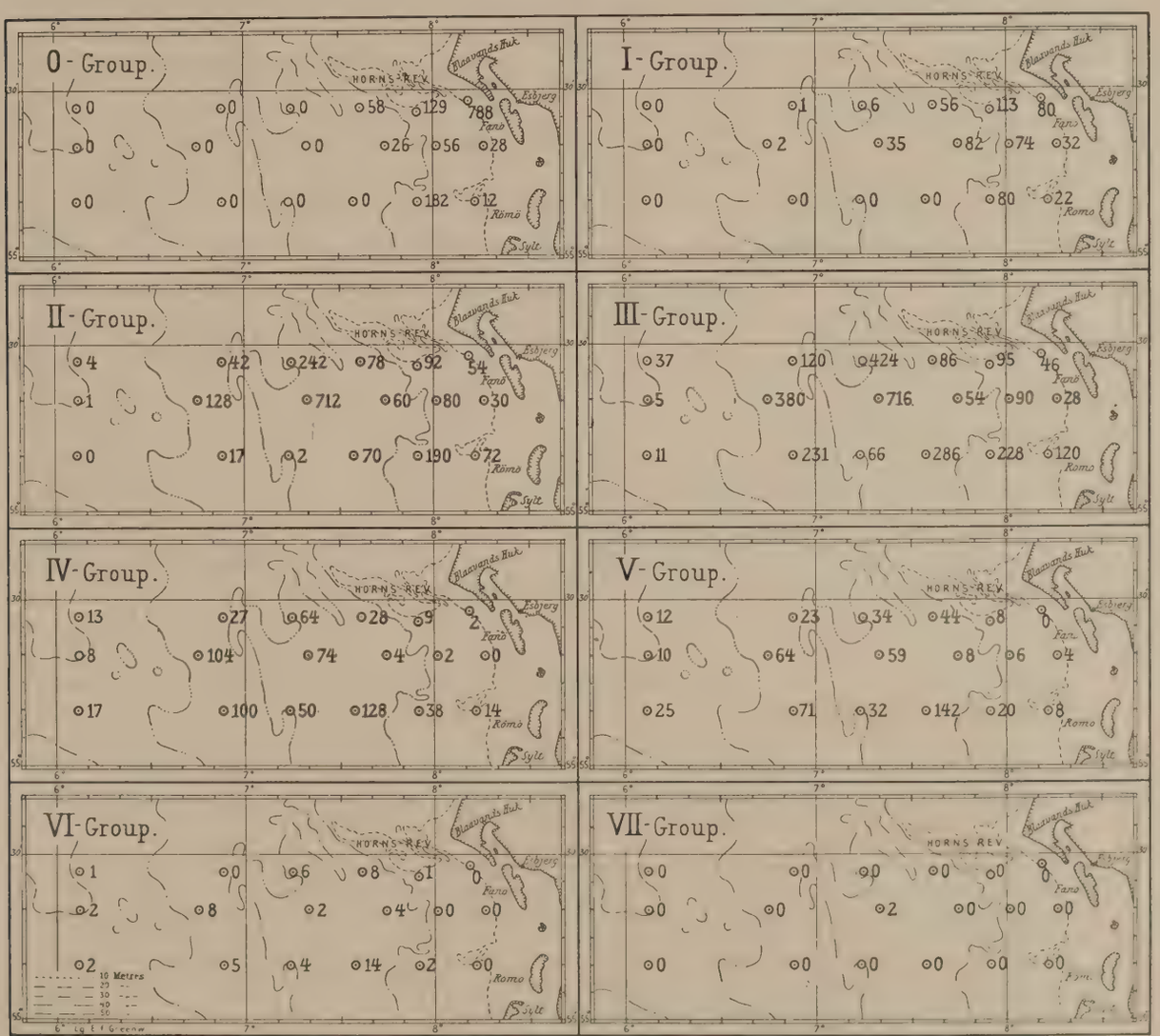


Fig. 4. Showing number of plaice of the different age groups caught per hour from s./s. "Dana" by a 50 ft. otter trawl with extra cod-end. — October 1925.

It will be noticed that the total stock which was found by fishing experiments in the spring was about three times less than that found in autumn, and that the difference is particularly marked in the catches of the younger age groups. About six times as many of the I- and II-groups were found in the autumn as in the spring.

This difference, as far as the I-, II-, and III-groups are concerned, may be ascribed to three causes. It may be assumed that the main cause is that a migration of these age groups from the coastal zone has taken place between the spring and autumn[1], but attention must also be paid to the fact that migrations from the more southern waters take place (see below). Moreover, it should be noticed that the fishing experiments in the spring were hardly sufficiently representative, as a great crowding of young plaice may take place in very limited localities without appearing in the experiments carried out. A pronounced crowding off Sylt has been shown by German investigations in 1926[2].

With the relatively few fishing experiments which it has been possible to undertake, it is therefore fairly fortuitous, in the case of these youngest age groups, as to how true a picture of the numbers of the stock has been given by the spring fishing experiments in the area outside the 10 metre line.

It is worthy of notice that fishing experiments carried out by German investigators between 54° 20′ and 55° 00′ N. Lat. in the young fish grounds, i. e. just south of the area dealt with here, revealed greater numbers of plaice under 20 cm. in length in July than in May[3].

Neither do the autumn fishing experiments outside the 10 metre line give a true picture of the numbers of plaice of the 0- and I-groups; the greater part of the youngest year classes is found during summer chiefly within the 10 metre line, partly at a depth of a few metres; the 0-group is thus chiefly found at a depth of 0—5 metres. In the course of the late summer and autumn they migrate out to rather deeper water, but this migration takes place at such different times in the different years and varies so greatly in extent that fishing experiments undertaken outside the 10 metre line do not give, especially for the 0-group, an accurate picture of the numbers of the stock.

It is peculiar that the number of plaice of the IV- and V-groups found in the area outside the 10 metre line during the autumn fishing experiments is $1^1/_2$ times as large as the numbers within these age groups found in this area during the spring experiments; one would have expected the number to be greater in the spring in view of the reduction in numbers of these age groups due to fishing. The reduction of plaice over 25 cm. in length amounted in the Horns Reef Area in 1925, as A. C. Johansen has found, to 55 per cent. in the course of one year[4] and should in the course of the months which elapsed between the spring and the autumn fishing experiments have amounted to a considerable proportion of the stock of these age groups, because about $^3/_4$ of the commercial catches from Esbjerg 1925 were landed in this period.

The difference in the numbers of plaice, revealed by the spring and autumn experiments, is therefore also in the case of these age groups so great that it can not be due to chance and must be the effect of biological conditions.

Probably the difference is mainly due to migrations from the inner zone or from more southern areas. A. C. Johansen[5] has pointed out that in June and July an emigration of plaice of over 20 cm.

[1] A. C. Johansen: Contributions to the Biology of the Plaice VI. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. IV. No. 4. 1913 and A. C. Johansen: Om Fiskebestanden i Graadyb og de tilstødende Kystvande. Naturens Verden. 1922. pp. 356 et seq.

[2] W. Mielck: Berichte d. Deutsch. wissenschaftl. Komm. für Meeresf. N. F. Bd. II. Hft. 4. 1926. p. 16 and A. Bückmann: Weitere Untersuchungen über Schongebiete für die Scholle in der Nordsee. Berichte d. deutsch. wissenschaftl. Komm. f. Meeresf. N. F. Bd. III. Hft. 1. 1927.

[3] W. Mielck in Fr. Heincke und W. Mielck: Schongebiete für die Scholle in der Nordsee. Berichte d. deutsch. wissenschaftl. Komm. f. Meeresf. N. F. Bd. II. Hft. 1. 1925. Charts 7 and 8. pp. 30 and 31.

[4] A. C. Johansen in Dansk Fiskeri-Beretning for Aaret 1925. p. 100.

[5] A. C. Johansen: Contributions to the Biology of the Plaice II. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. II. No. 5. 1907. p. 78.

in length takes place away from the southern Horns Reef Area in a north-westerly direction simultaneously with their dispersal towards the deeper water.

It will be noticed that the VI-group is caught in somewhat greater numbers in spring than in autumn, but the numbers were in both seasons rather small.

The investigation suggests that less representative value should be attached to the numbers of the III-group caught in the spring in the southern Horns Reef Area outside the 10 metre line than to the numbers of this age group caught in the autumn, and that this holds good to an even higher degree as regards the stock of plaice of the II-group. Plaice of the 0- and I-groups are not found in the area outside the 10 metre line either in spring or in autumn, but particularly not in spring, in sufficient numbers to enable a completely reliable valuation of the stock to be made, by fishing experiments of the extent hitherto found practicable.

III. Fluctuations in numbers and distribution of the total stock in the southern Horns Reef Area outside the 10 metre line.

1. The numbers of the stock.

Autumn fishing experiments. For comparison with the charts Figs. 3 and 4, which show the distribution and frequency of the plaice in 1925, in Fig. 5 is shown the distribution and frequency of the plaice in the autumns of 1903 and 1904, classified according to size groups and with the total numbers caught per hour. The material from the autumn of 1922 is presented on charts published by Kirstine Smith in 1923 in Medd. f. Komm. f. Havunders. Bd. VII. No. 4. pp. 4, 5. Figs. 1, 2. By comparing chart Fig. 3, p. 8 for the autumn of 1925 with chart Fig. 5 for the autumns of 1903 and 1904, it will be seen that the stock in 1925, as in 1922, was considerably greater than that in 1903 and 1904. The greatest catch per hour's trawling in 1925 was 1599 plaice, the greatest in 1903 and 1904 was 470.

In Table 6 is presented the material from the autumn fishing experiments of 1903 and 1904, classified according to size groups and depth zones, and in Tables 7 and 8 is presented the material from the autumn of 1922, classified according to size groups and age groups in the same manner as the material for the autumn of 1925 is shown in Tables 3 and 4.

Table 6. Average numbers of plaice of different size groups and total numbers caught per hour with 50 ft. otter trawl in the autumns of 1903 and 1904 in the southern Horns Reef Area outside the 10 metre line.

Depth-zone m.	Average depth m.	Number of stations	Size groups, cm.							Total
			5—9	10—14	15—19	20—24	25—29	30—34	35—57	
10—19	18	2	24	172	96	37	6	0	0	333
20—29	25	3	0	38	215	107	49	1	0	411
30—39	31	1	0	0	4	100	86	6	0	198
> 40	46	4	0	0	0	1	6	1	1	9

Table 7. Average numbers of plaice of the different size groups and total numbers caught per hour with 50 ft. otter trawl in the autumn of 1922 (September 13th—26th) in the southern Horns Reef Area outside the 10 metre line.

Depth-zone m.	Average depth m.	Number of stations	Size groups, cm.							Total
			0—4	5—9	10—14	15—19	20—24	25—29	30—34	
10—19	15	6	2	281	287	94	12	2	0	678
20—29	24	7	0	20	429	197	23	3	0	672
30—39	32	4	0	0	51	97	69	9	0	226
> 40	44	4	0	0	0	1	6	4	1	13

Table 8. Average numbers of plaice of the different age-groups caught per hour with 50 ft. otter trawl in the autumn of 1922 (September 13th—26th) in the southern Horns Reef Area outside the 10 metre line.

Depth-zone m.	Average depth m.	Number of stations	Age groups							
			0	I	II	III	IV	V	VI	VII
10—19	15	6	262	196	168	37	12	1	0	0
20—29	24	7	13	269	324	56	5	1	0	0
30—39	32	4	0	16	98	83	21	5	1	0
> 40	44	4	0	0	4	6	2	1	0	0

By placing in separate columns the total numbers in the depth zones in the autumns of 1903 and 1904, 1922, and 1925 we obtain

Table 9. Total numbers of plaice caught per hour in the different depth zones.

Depth zone	1903 and 1904	1922	1925
10—19	333	678	373
20—29	411	672	722
30—39	198	226	372
> 40	9	13	49

In comparing the numbers of plaice caught per hour during the years 1903—07 with those caught during the years 1922—27, it must be observed that the extra cod-end of the trawl was probably somewhat smaller in the former than in the latter period. If this was the case, the difference in the efficacy of the trawl would however only have affected the smaller plaice. In the table below therefore, only the numbers of plaice over 15 cm. in length are compared.

Table 10. Numbers of plaice over 15 cm. in length caught per hour in the different depth zones.

Depth zones	1903 and 1904	1922	1925
10—19	138	108	225
20—29	373	223	648
30—39	198	175	372
> 40	9	13	49

It will be seen from tables 9 and 10, as from the charts, that the total numbers per hour in 1925 were as in 1922 considerably above the numbers in 1903 and 1904, but that the numbers of plaice over 15 cm. in 1903 and 1904 was greater than that in 1922 and less than that in 1925.

Moreover it will be seen, upon referring to the proportions given on p. 8 between the areas of the zones, that the total numbers found at the fishing experiments in 1925 were about the same as in 1922, but that in the depth zone 10—19 metres was found less abundance of plaice in 1925 than in 1922, whilst in the outer depth zones a greater density of plaice were found in 1925.

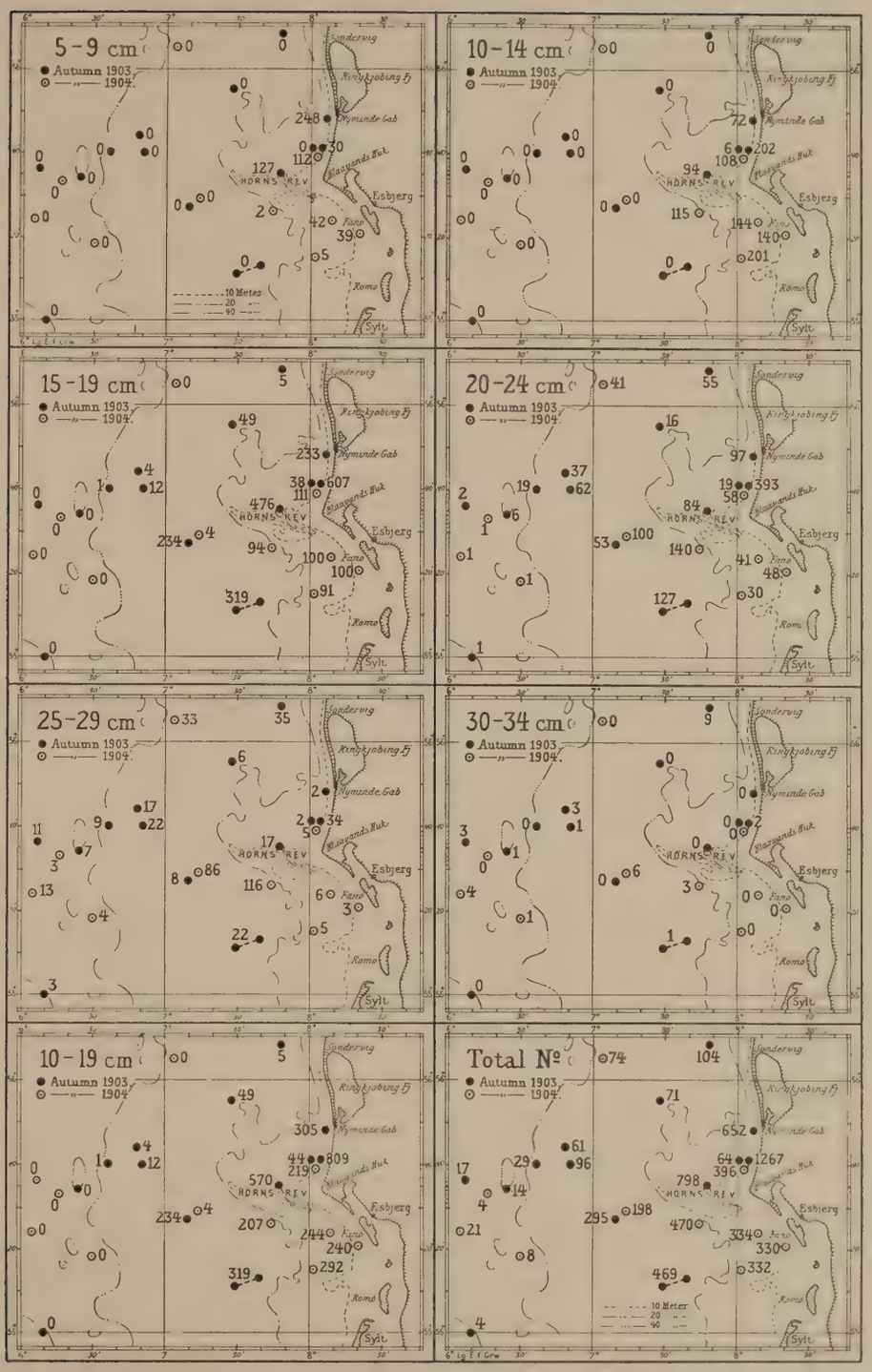


Fig. 5. Showing number of plaice of the different size groups caught per hour from s./s. "Thor" by a 50 ft. otter trawl with extra cod-end. — Autumns of 1903 and 1904.

From Tables 4, p. 6 and 8, p. 12 we see that this is due chiefly to the fact that a far greater number of plaice of the 0- and I-groups were found in the autumn fishing experiments in 1922 than in those of the autumn of 1925, whereas the age groups older than II were more frequent in 1925. The determination of the numbers of plaice of age groups 0 and I is, as mentioned on p. 10, subject to some uncertainty. By comparing the numbers within the age groups II—VI we obtain:

Table 11. Numbers of plaice of age groups II—VI caught per hour in the different depth zones.

Depth zones	1922	1925
10—19	220	227
20—29	390	670
30—39	210	371
> 40	13	49

The numbers of plaice of these age groups in the area in question will be seen therefore, when the proportion between the areas of the zones is taken into consideration, to have been in the autumn of 1925 nearly double as great as in the autumn of 1922.

Spring fishing experiments: the numbers of plaice of the different size and age groups, spring 1925, are shown on the charts Figs. 1, p. 5 and 2, p. 7 and in the Tables 1, p. 5 and 2, p. 6; on the charts Figs. 6 and 7 and in the Tables 12 and 13 are shown the corresponding numbers of plaice of the different size and age groups, spring 1927.

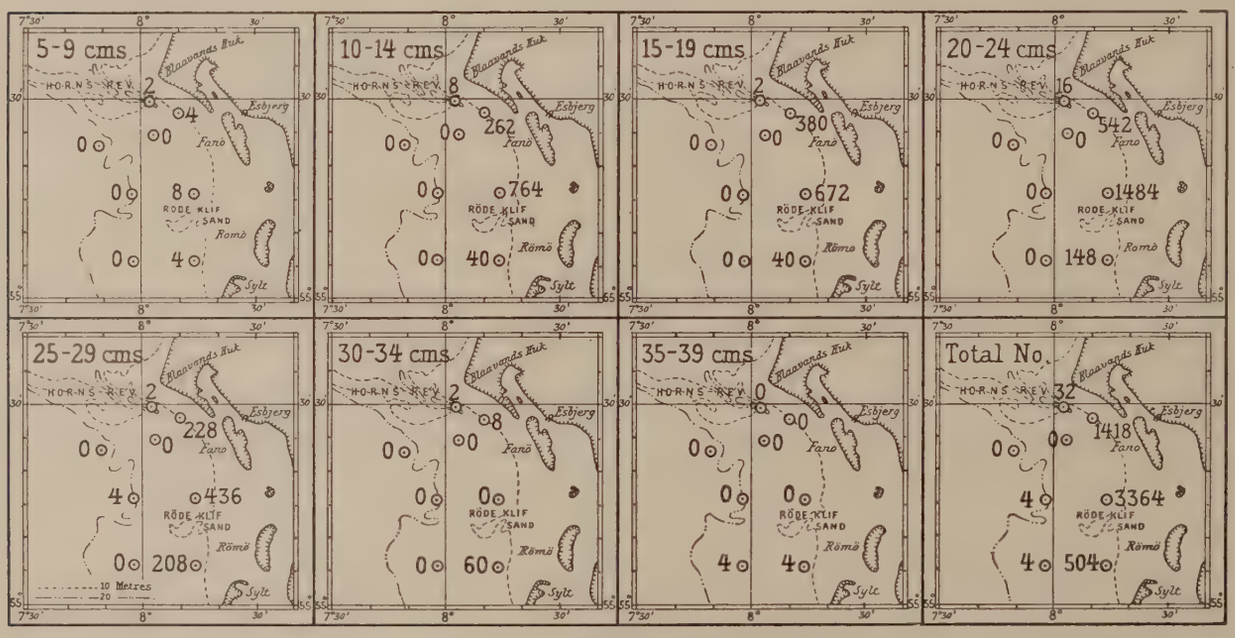


Fig. 6. Showing number of plaice of the different size groups and total number caught per hour from s./s. "Dana" by a 50 ft. otter trawl with extra cod-end. — March 1927.

In Table 14 are shown the numbers of plaice of the different size groups caught by fishing experiments in the springs of 1903, 1904, and 1905 and in Tables 15 and 16 the numbers of the different size and age groups respectively caught at fishing experiments in the spring of 1907.

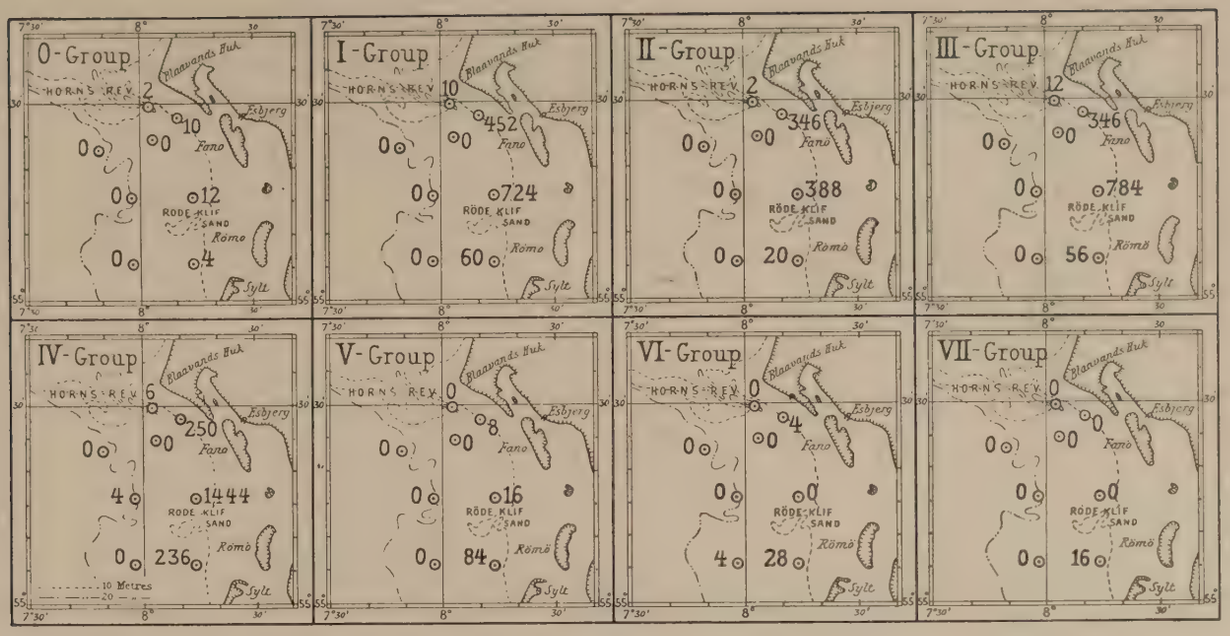


Fig. 7. Showing number of plaice of the different age groups caught per hour from s./s. "Dana" by a 50 ft. otter trawl with extra cod-end. — March 1927.

Table 12. Numbers of plaice of the different size groups, together with totals, caught per hour with 50 ft. otter trawl in the spring of 1927 (March 28th—30th) in the southern Horns Reef Area outside the 10 metre line.

Depth m.	Stat. No.	Size groups, cm.							Total
		5—9	10—14	15—19	20—24	25—29	30—34	35—39	
10	3702	4	262	380	542	228	8	0	1424
12	3707	4	40	40	148	208	60	4	504
13	3704	8	764	672	1484	436	0	0	3364
14	3708	0	0	0	0	0	0	0	0
18	3705	0	0	0	0	4	0	0	4
18	3706	0	0	0	0	0	0	4	4
24	3709	0	0	0	0	0	0	0	0

It will be noticed that the total numbers caught at a single station were greatest in 1927 (3364 plaice in one hour), and that the total numbers in this region seem to have been greater in 1925 and 1927 than in the years prior to the war and particularly 1907.

The great variation in distribution for the different years renders difficult a direct comparison of the quantity of plaice actually present in the region in question. A better basis for comparison is provided by the method which was employed to obtain an expression for the numerical strength of the spring stock in the region in question in the spring of 1925 (see p. 7), each of the fishing experiments carried out in the area between the 10 and 20 metre line being regarded, in view of the fairly even distribution of stations of this area, as representing equally large sections of the area and when taken together as representing the whole.

Table 13. Numbers of Plaice of the different age groups caught per hour with 50 ft. otter trawl in the spring of 1927 (March 28th—30th) in the southern Horns Reef Area outside the 10 metre line.

Depth m.	Stat. No.	Age groups							
		0	I	II	III	IV	V	VI	VII
10	3702	10	452	346	346	250	10	4	0
12	3707	4	60	20	56	236	84	28	16
13	3704	12	724	388	784	1444	16	0	0
14	3708	0	0	0	0	0	0	0	0
18	3705	0	0	0	0	4	0	0	0
18	3706	0	0	0	0	0	0	4	0
24	3709	0	0	0	0	0	0	0	0

Table 14. Numbers of plaice of the different size groups, together with totals, caught per hour with 50 ft. otter trawl in the springs of 1903, 1904, and 1905 in the southern Horns Reef Area outside the 10 metre line.

Year	Date	Depth m.	Stat. No.	Size groups, cm.						Total
				5—9	10—14	15—19	20—24	25—29	30—34	
1903.....	10/IV	18.5	38—39	1	54	55	91	66	3	270
1904.....	22—25/II	14	192	10	14	72	95	31	1	222
1904.....	26, 29/II	15	201	6	68	656	482	64	1	1276
1905.....	15/IV	14	381	1	55	79	64	36	3	239

Table 15. Numbers of plaice of the different size groups caught per hour with 50 ft. otter trawl in the spring of 1907 (April 27th—May 7th) in the southern Horns Reef Area outside the 10 metre line.

Depth m.	Stat. No.	Size groups, cm.								
		5—9	10—14	15—19	20—24	25—29	30—34	35—39	40—44	45—49
12	976	148	220	90	99	16	1	0	0	0
13	993	38	78	62	44	6	0	0	0	0
15	975	1	29	15	26	9	1	0	0	0
17	995	2	10	22	22	14	1	0	0	0
18	1002	3	13	22	27	8	6	2	0	0
22	996	0	0	0	2	1	0	0	0	0
23	1001	0	0	0	0	0	0	1	0	0
26	997	0	0	0	0	0	0	0	0	0
26	999	0	0	0	1	0	1	0	0	0
27	1000	0	0	0	0	1	1	1	0	0
28	998	0	0	0	1	0	0	1	0	0
32	991	0	0	0	0	0	2	0	0	0
40	990	0	0	0	0	0	0	0	0	1
45	989	0	0	0	0	0	0	0	0	0
49	988	0	0	0	1	1	0	0	0	0

Table 16. Numbers of plaice of the different age groups, together with totals, caught per hour with 50 ft. otter trawl in the spring of 1907 (April 27th—May 7th) in the southern Horns Reef Area outside the 10 metre line.

Depth m.	Stat. No.	Age groups					Total
		I	II	III	IV	V+	
13	993	30	101	82	12	0	228
15	975	0	34	32	12	0	80
17	995	2	17	39	11	0	71
18	1002	2	24	39	12	2	81
22	996	0	0	1	1	1	3
23	1001	0	0	0	0	1	1
26	997	0	0	0	0	0	0
26	999	0	0	1	1	0	2
27	1000	0	0	1	1	1	3
28	998	0	0	1	0	1	2
32	991	0	0	0	1	0	2
40	990	0	0	0	0	1	1
45	989	0	0	0	0	0	0
49	988	0	0	1	1	0	2
Moreover :							
12	976	not analysed for age groups					574

The average numbers of plaice caught per hour in this area are given below in Table 17.

Table 17. Comparison between the numbers of plaice of the different age groups caught per hour at depths between 10 and 20 metres in the southern Horns Reef Area in the springs of 1907, 1925, and 1927.

Year	Average depth m.	Number of stations	Age groups								Total
			I	II	III	IV	V	VI	VII	VIII	
1907[1]	16	4	14	64	64	14	1[2]				157
1925	15	6	23	107	354	147	127	29	0	0	792
1927[3]	14	6	4	206	126	198	322	18	6	3	883

In comparing the autumn fishing experiments of 1922 and 1925 it has been mentioned that there has possibly been some difference between the size of the fine-meshed extra cod-end of the trawl as used in the fishing experiments prior to the war and that used in the post-war experiments, and that this difference may have affected the number of the smallest plaice caught. A comparison of the numbers of plaice caught over 15 cm. in length, is therefore given below.

Numbers of plaice over 15 cm. in length caught per hour in the area between the 10 and 20 metre lines in the southern Horns Reef Area in the springs of 1903-1904-1905, 1907, 1925, and 1927.

1903, 1904, and 1905 : 450
1907 : 99
1925 : 580
1927 : 703

[1] It may be assumed that the percentual distribution as to age groups was the same at Stat. 976 as at Stat. 993.
[2] V+.
[3] The 1927 catches are from the 28th to the 30th of March; for the sake of comparison the age groups are altered to after April 1st by the addition af 1 to each age group.

It will be observed that in both 1925 and 1927 the stock was considerably larger than in the years prior to the war. The total numbers yielded by the fishing experiments in the area in question were about the same for the two years.

The numbers of I- and II-group plaice in the catches are however of somewhat less value for judging the numbers of plaice of these age groups (cp. pp. 4—11). The comparison below is therefore limited to the age groups III—VIII and IV—VIII.

Mean numbers of age groups III—VIII and IV—VIII caught per hour in the area between the 10 and 20 metre lines in the southern Horns Reef Area in the springs of 1907, 1925, and 1927.

	1907	1925	1927
Numbers of groups III—VIII	79	657	673
— - — IV—VIII	15	303	547

The numbers of plaice in these age groups were the same in 1925 and 1927 in the case of the age groups III—VIII and greater in 1927 than in 1925 in the case of the age groups IV—VIII alone. It will be noticed from Table 17 that these older age groups were very much more numerous in 1925 and 1927 than in 1907.

It has been shown by comparison that the total numbers of plaice found by fishing experiments in the southern Horns Reef Area outside the 10 metre line was approximately the same for the three years 1922, 1925, and 1927, but that in the course of these years the proportion of older plaice in the composition of the stock steadily increased. Since the stock of plaice of any year class is steadily reduced in numbers from year to year, the total stock in the southern Horns Reef Area, when the whole area is taken into consideration, must have been greatest in 1922, less in 1925, and least in 1927, the younger year classes being present in the greatest density in the inmost depth zone 0—9 metres.

2. The distribution of the stock.

It is of special interest to investigate whether the stock as a whole in the northern part of the nursery grounds for young plaice in the south-eastern North Sea reveals any changes in the distribution of a similar nature to those pointed out by Borley and Collaborators on the Leman-Haaks line in the southernmost part of these nursery grounds[1], where they have shown that the centre of gravity of the age groups III, IV, and V+ was found directly after the war nearest to the coast where the plaice were banked up and that it in the course of the years 1920, 1922, and 1924 moved outwards.

The depth of the centre of gravity or the mean depth of the different age groups in the southern Horns Reef Area outside the 10 metre line is in Table 18 calculated in the same way as its distance from the coast is calculated for the different age groups in the English investigation mentioned above, taking into account the relation between the areas of the depth zones.

As will be discussed more closely later, the relative frequencies of males and females were not the same in 1922 as in 1925. The depths of the centres of gravity are calculated separately for the distribution of the two sexes, since it was proved for the autumn of 1922 by Kirstine Smith by an investigation of the relative frequencies of males and females that the centre of gravity of the male population was found to be in deeper water than the centre of gravity of the female population, which was explained thus: "even before maturity is reached, males of the young age groups have a greater inclination to leave the coastal grounds than females of the same age"[2].

[1] J. O. Borley and Collaborators: The Plaice Fishery and the War. Ministry of Agriculture and Fisheries. Fish. Invest. Ser. II. Vol. V. No. 3. 1923. p. 28 and J. O. Borley and D. E. Thursby-Pelham: Report on the English Plaice Investigations in the North Sea during the years 1921—1923. Ministry of Agriculture and Fisheries. Fish. Invest. Ser. II. Vol. VII. No. 6. 1925. pp. 46—48.

[2] Kirstine Smith, id. 1923. p. 18.

Table 18. The depth of the centre of gravity in metres of the distribution of the different age groups calculated for males and females in the autumns of 1922 and 1925 in the southern Horns Reef Area outside the 10 metre line.

		II	III	IV	V	VI
♂♂	1922	23.3	26.5	28.2	28.0	
	1925	24.9	26.4	28.0	28.7	27.0
♀♀	1922	22.0	24.3	25.4	26.8	
	1925	24.0	25.5	27.5	27.2	26.0

It will be noticed that in the autumns of both 1922 and 1925 the centre of gravity for males, when plaice of the same age group are considered, is found in deeper water, i. e. further from the coast, than that for females.

It will moreover be noticed that it is only for females that a considerable difference occurs between the two years with respect to the depth of the centre of gravity, when the same age groups are considered, as they were found in deeper water in October 1925 than in September 1922. In the case of the males, the difference in the depth of the centre of gravity, when the same age group is considered, is so slight that one can scarcely decide whether this difference actually exists, except as regards age group II where the centre of gravity is found at greater depth in 1925 than in 1922.

The difference found in the mean depth of the females cannot be explained by normal migrations. The fishing experiments of 1922 were undertaken in September, those of 1925 in October, and from our knowledge of normal migrations we should have expected that both males and females in October 1925 would have had the centres of gravity of their distribution nearer the coast than in September 1922. A. C. Johansen has namely shown that plaice move outwards in June, July, and August, and that part of the immature plaice migrate in September and October to shallower water, whilst the mature plaice remain out in the deeper water[1].

Since now the centre of gravity was found at the same depth in October 1925 as in September 1922 in the case of the males, and at a greater depth in October 1925 than in September 1922 in the case of the females, it was consequently possible, both as regards males and females, to discern an indication of the facts pointed out by Borley and Thursby-Pelham, namely that plaice in the nursery grounds on the Leman-Haaks line had the centre of gravity of their distribution nearer the coast immediately after the war than before it, and that the centre of gravity moved steadily outwards in the years 1920, 1922, and 1924 so that "the marked banking up inshore of the plaice stock so noticeable in 1920, has now been reversed as far as the III- and IV-year groups and younger groups are concerned, the movement out to sea having extended even farther than in 1906"[2].

As regards the Horns Reef Area the distribution of the various age groups is not a result of a banking up of plaice. As shown in the following it must be assumed that the distribution has been in full accordance with the average lengths of the various age groups. These were, as is shown in detail in Chapter V, greater in 1925 than in 1922.

By investigating the depth of the centre of gravity for the plaice of the various size groups in the same way as has been done for the plaice of the various age groups, we obtain the values given in Table 19.

It will be noticed that the centre of gravity for the plaice of the same size group was found at a greater depth in 1922 than in 1925 or at nearly the same depth except in the case of the size group 5—9 cm. which is only sparsely represented in this area.

[1] A. C. Johansen: Contributions to the Biology of the Plaice I and II. Medd. f. Komm. f. Havunders. Bd. I. No. 2. 1905. p. 25 and Bd. II. No. 5. 1907 p. 78.

[2] J. O. Borley and D. E. Thursby-Pelham, id. 1925. p. 48.

Table 19. The depth of the centre of gravity in metres for the various size groups of plaice in the southern Horns Reef Area outside the 10 metre line.

	5—9	10—14	15—19	20—24	25—29	30—34 cm.
Autumn 1922	16.1	22.2	23.9	28.8	31.6	(44.0)
— 1925	17.8	21.4	24.2	26.8	30.3	32.8

That the centre of gravity for the same size group was found at a somewhat greater depth in September 1922 than in October 1925 at the fishing experiments was to be expected, after the observation, mentioned above, of JOHANSEN to the effect that the immature plaice move towards the coast in these months.

A. C. JOHANSEN and KIRSTINE SMITH have pointed out[1] that from an investigation of marketable plaice from the Horns Reef Area in 1919 no change could be deduced in the number of smaller plaice near the coast.

If we turn to a comparison of the distribution during the spring fishing experiments undertaken in 1903—05, 1907, 1925, and 1927 it will be seen that the distribution in these years seems to have been very unequal.

In February—April 1903—05 the dense population of plaice was found at any rate up to a depth of 18.5 metres, round about May 1st 1907 it ceased at 18 metres and at the beginning of April 1925 at 20 metres, but in the last days of March 1927 already at 13 metres.

An attempt to find the cause of these variations in the distribution of the spring stock in the temperature (recorded at the lightships of Vyl and Horns Reef) has shown that the temperature is apparently not the cause.

IV. Relative frequency of the separate year classes.[2]

a) Changes in the age composition of the catches from 1922 to 1927.

In Fig. 8 is shown graphically a comparison between the catches of the different age groups in the autumns of 1922 and 1925, the catches per hour in the different depth zones being compared. In Fig. 9 the catches in the springs of 1925 and 1927 are compared.

We see from these graphs that in the course of the years 1922—1927 a change has taken place in the composition of the catches in the southern Horns Reef Area outside the 10 metre line; whilst in 1922 it was the age groups I and II which predominated numerically in the catches in the depth zones in question, in 1925 and 1927 it was the age groups II—V which were predominant, in 1925 the greatest numbers being in the III-group and in 1927 in the V-group.

This material from the fishing experiments can be made use of for the purpose of estimating the relative frequencies of the different year classes.

b) Methods for estimating the relative frequencies of the different year classes.

A determination of the relative frequencies of the different year classes based on a determination of egg production is impossible, seeing that the number of eggs and young fry which perish may be assumed to vary greatly from one year to another.[3]

[1] A. C. JOHANSEN and KIRSTINE SMITH: Investigations as to the effect of the restriction on fishing during the war on the Plaice of the eastern North Sea. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd.V. No. 9. 1919.

[2] The frequency of a year class is understood here to mean its numerical strength as the result of egg production and survival.

[3] Compare W. MIELCK: Die Arbeiten der Biologische Anstalt auf Helgoland. Ber. d. Deutschen wissensch. Komm. f. Meeresf. N. F. Bd. II. Hft. 4. 1926. pp. 17—19 and A. C. JOHANSEN: On the Fluctuations in the Quantity of Young Fry among Plaice and certain other species of fish, and causes of the same. Report of the Danish Biological Station XXXIII, 1927. pp. 6—7.

The determination of the frequencies of the 0- and I-groups in this region is connected with great difficulties. It is probable that considerable numbers of young plaice come to this region from the south, as the inner corner of the German Bight seems, according to the German coastal investigations, to be of much more importance as nursery grounds for these age groups. The difficulties involved in the method were discussed in detail by A. C. JOHANSEN in 1908. [1]

An estimate of the relative frequencies of the different year classes, based on the relative frequencies of the age groups in the catches made during the fishing experiments mentioned here, is however possible. The age composition of the stock in a certain area is determined by the following factors: 1) the frequencies of the year classes, visiting the area in question, 2) the migrations of the stock, 3) natural mortality, 4) the effect of fishing upon the stock. If we know the age composition of the stock, we can determine the relative frequencies of the different year classes, when we know or can eliminate the three last factors. We can proceed in two ways: by investigating the relation between the numbers in the same age group for various years and by comparing the relative frequencies of the various age groups in the catches in a single year.

The first procedure is easy to

[1]) A. C. JOHANSEN: On the variation in frequency of young Plaice in Danish waters in 1902—07. Contributions to the Biology of the Plaice etc. III. Medd. f. Komm. f. Havunders. Bd. III. No. 4. 1908.

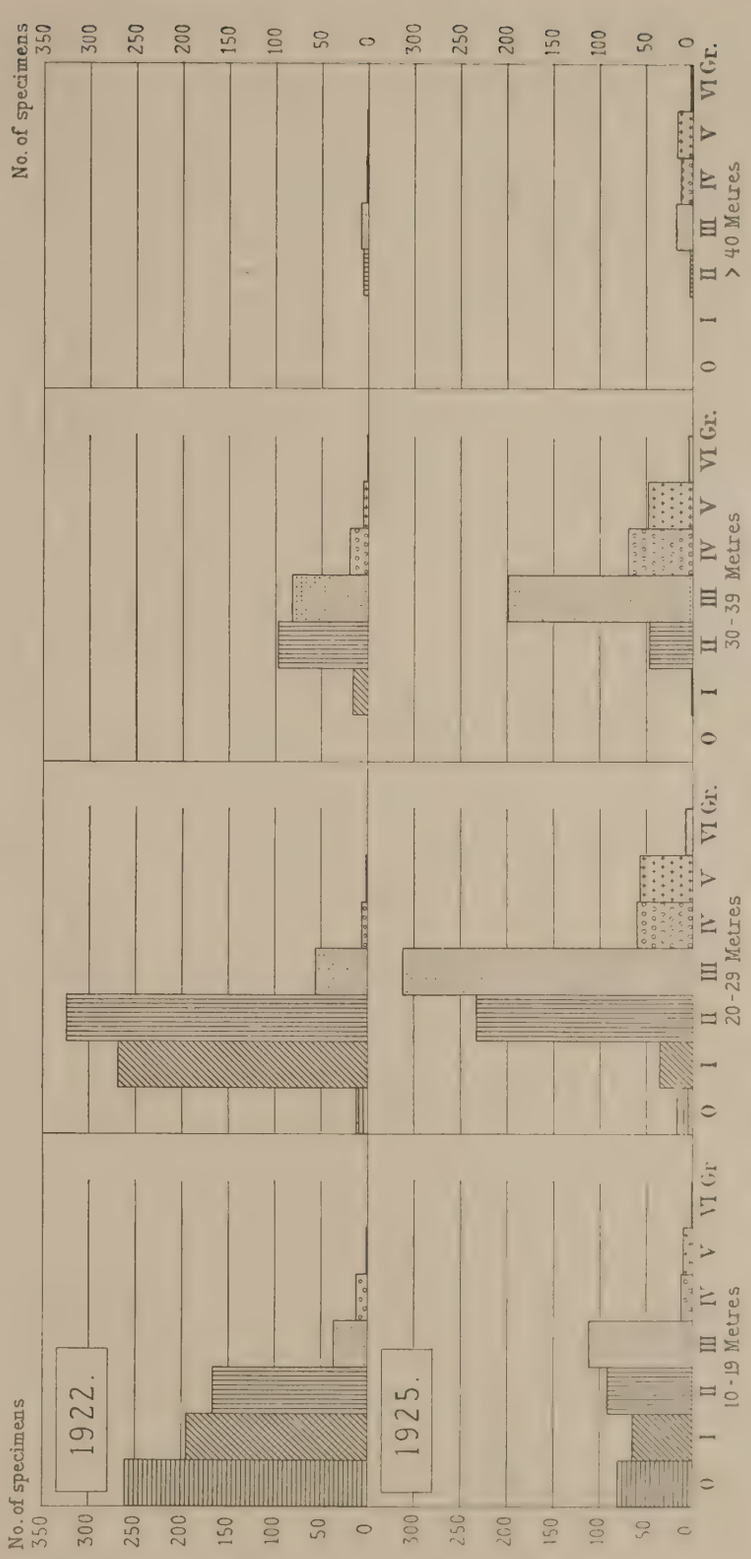


Fig. 8. Showing mean catch of the various age groups taken per hour with a 50 ft. otter trawl in the different depth zones of the southern Horns Reef Area in the autumns of 1922 and 1925.

adopt if three conditions are fulfilled, firstly that the intensity of fishing remains unchanged, i. e. that year after year the same percentage of the same size group of plaice is taken, secondly that the stock is observed for two years at the same season so that the effect of migrations can be assumed to influence to only a slight extent the relation between the numbers of the plaice for the two years in the area in question, and thirdly that the length of the same age group is the same year after year.

If these three conditions are fulfilled, the relation between the numbers of two year classes for the same age group will be a direct measure for the relation between the relative frequencies of the year classes visiting the area in question.

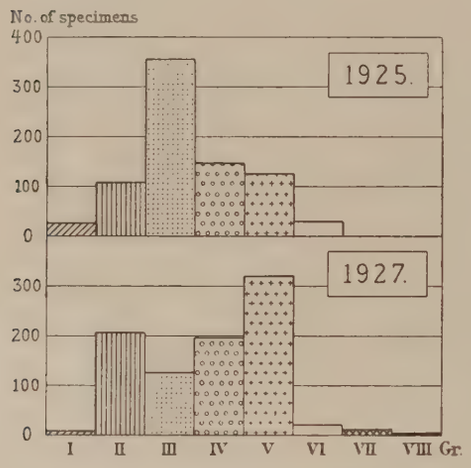


Fig. 9. Showing mean catch of the various age groups taken per hour with a 50 ft. otter trawl in the area between the 10 and 20 metres lines in the springs of 1925 and 1927.

The other procedure, namely to deduce the relative frequencies of the different year classes from our knowledge of the age composition of the stock in the area in question during a single year, demands not only that the intensity of fishing and the rate of growth have remained unchanged year after year but also that we know the normal age composition of the stock in the area in question.

If this is the case, we have, in the relation between the numbers of the different year classes and the normal numbers in the age group which the year class forms, a measure for the relative frequency of the different year classes visiting the area.

If the intensity of fishing varies from year to year, we can as a rule only obtain a rough estimate, and this is the case also to some extent if the length of the different age groups varies from year to year, the age composition of the stock in a certain area being altered partly because the biological conditions of the same age group are altered, and partly because the effect of fishing on the stock will bring about a different age composition of the stock.

c) Changes in the effect of fishing on the stock.

The annual percentage of recaptures in the marking experiments enable us to gauge, as A. C. Johansen pointed out in 1906[1], the reduction, inflicted by fishing on the stock of marketable plaice, and thereby the intensity of fishing. This yearly reduction amounted according to Johansen in the years prior to the war in the Horns Reef Area to 53 per cent. in the marking experiments which were undertaken in March and April[2]. During the spring marking experiments in 1920 and 1921 recaptures in the course of the first year amounted to 44 per cent[3] and during the spring experiments in 1925 the reduction in the course of the first year amounted to 55 per cent.[4] The variations in the percentage of recaptures seem thus to have been small and can be partially accounted for by the time in spring when the marking experiments were undertaken, in that the percentage of recaptures becomes less the later in the spring the marking is carried out, and the marking in 1920—21 took place on the 23rd and the 24th of April, and on the 28th of May, and in 1925 on the 2nd of April.

[1] A. C. Johansen: Über die Schollenfischerei im Kattegat und die Mittel, sie zu heben. Cons. Perm. Intern. p. l'Explor. de la Mer. Rapports et Procès-Verbaux. Vol. V. 1906. pp. 115 et seq.

[2] A. C. Johansen: Marking Experiments with Plaice in the North Sea of the West Coast of Jutland during the Years 1906—1912. Contributions to the Biology of the plaice VII. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. IV. No. 9. 1915. p. 23.

[3] Kirstine Smith: On the Plaice Population of the Horns Reef Area in the Autumn of 1922. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. VII. No. 4. 1923. p. 35.

[4] A. C. Johansen in Dansk Fiskeri-Beretning for Aaret 1925. p. 100.

Marking experiments however throw no light on the degree to which fishing affects the plaice which are smaller than those marked, and, as is discussed in detail below, two changes in the intensity of fishing have taken place which may be assumed to influence the numbers of the various year classes in the southern Horns Reef Area.

The effect of fishing on the stock has moreover changed considerably, owing to the average length of the different age groups having changed. The small average length of the different age groups in the years directly after the war caused a far lower percentage particularly of the III- and IV-age groups to be subject to fishing in these years, i. e. it caused the year classes older than 1919 to be spared to a considerable extent. Owing to the changes in the average length of the different age groups, the youngest age groups became comparatively more numerous in the area outside the 10 metre line during the years 1922—1927.

Two circumstances connected with the intensity of fishing may be assumed to be of importance for the plaice stock of the southern Horns Reef Area. The younger year classes were during the last years of the war and directly after it, especially in the German Bight of the North Sea, subjected to very intense fishing. This fishing was carried on with such intensity that in spite of the fact that only the young fish grounds in the German Bight were partially open to the German fishery, the weight of the yield of the German plaice fishery during the years 1917, 1918, and 1919 was over twice as great as the yield during the years prior to the war.

Heincke and Mielck [1] have pointed out that an extensive trawl fishery in this area means that an extraordinarily great reduction in numbers of the younger age groups has taken place.

In addition to a very great number of plaice over 20 cm. in length having been caught by fishing operations during the last years of the war and directly after it, a still greater number of plaice under 20 cm. in length have been destroyed. Heincke and Mielck have calculated that for every marketable plaice caught over 25 cm. in length, 25 young plaice of little value were destroyed [2].

The fishing operations of a steam trawler cover about 250 hectares per day, and since the area of the inner zone (0—22 metres' depth), for which closure has been suggested, is only about 1500 times this area [3], and since over half of the important nursery grounds in the southern and south-eastern North Sea, from which principally all the plaice stock of the North Sea is recruited, lie off the German coasts, extensive trawling operations for some years round about the close of the war must have caused a considerable reduction in the numbers of the year classes which were then growing up.

The very low numbers of the year classes 1916—1917, and to some extent also of the 1918 year class itself, compared with the numbers of the year classes after 1919 in the southern Horns Reef Area (see Table 20, p. 25) must also, it seems, be ascribed, as regards a considerable proportion, to this intensive fishery on the young fish grounds during the last part of the period when mines were present in the deeper waters. We must assume that the relatively great protection afforded these year classes during the years immediately after the war by reason of the small average length of the age groups III and IV was not sufficient to counterbalance the reduction to which these year classes were subjected in the German Bight.

The alterations in the extent of area covered by the English trawl fishery must be looked upon as another change in fishery affecting the age composition of the stock during the years subsequent to the war.

It was not until the stock which had accumulated in the open North Sea had been gradually captured, whilst at the same time the stock in the nursery grounds improved from a commercial point of view, that the English trawlers extended their field of operations to cover the eastern parts of the

[1] Fr. Heincke und W. Mielck: Schongebiete für die Scholle in der Nordsee. Ber. d. deutschen wissensch. Komm. f. Meeresf. N. F. Bd. II. Hft. 1. 1925. pp. 39 et seq.

[2] Id. p. 40.

[3] Id. p. 41.

North Sea [1]. This protection of the stock in the Horns Reef Area which ceased with the extension of the English trawl fishery, must have contributed to a higher proportion of the year classes 1918, 1919, 1920 being present in the area than would have been if in these years an equally intensive trawling had taken place in this area as took place in the following years.

We may assume therefore that the changes in the effect of the fishery on the stock caused comparatively many plaice, older than 1918, to be captured, whilst the numbers of the year classes 1919 and 1920 became comparatively high. The year class 1918 was reduced to a comparatively large extent by the above-mentioned German fishery during the years round about the close of the war, but was spared later owing to the English trawlers not including the southern Horns Reef Area within their field of operations to any appreciable extent until some years after the war had come to an end.

d) The numbers of plaice in the various age groups caught at the fishing experiments.

When determining the relative frequencies of the various year classes, we must moreover take into consideration the considerable uncertainty prevailing as to the determination of the frequency of the youngest age groups.

The autumn fishing experiments outside the 10 metre line do not give, as is mentioned on page 10, an expression which can be compared from year to year for the stock of plaice in the 0- and I-groups, because the time at which these age groups migrate from the coastal zone varies from year to year and because also the extent to which these age groups migrate from the coastal zone 0—10 metres varies from year to year.

The spring fishing experiments represent adequately the size of the stock from year to year only as regards plaice aged three years or more, because the age groups I and II are in the spring too poorly represented at the fishing experiments of the scope which has been found possible (cp. p. 10).

If the difference in the numbers of captured plaice in these younger age groups varies considerably from year to year, we may perhaps deduce with some degree of certainty a difference of the same nature between the relative frequencies of the corresponding year classes.

e) Comparison between the relative frequencies of the various year classes.

We are now in a position to undertake a systematic investigation of the age composition of the stock for the purpose of thereby estimating the relative frequencies of the various year classes. The results of previous experiments with this object in view in the Horns Reef Area and in the rest of the North Sea will be given in the following section and compared with the results here arrived at.

Autumn fishing experiments 1922 and 1925. In order to obtain an expression, which can be compared from year to year, for how high the number of plaice of the various age groups are in the area in question during the autumns of 1922 and 1925, the same method of calculation is employed as in the comparison between the spring and autumn stock in 1925 (see p. 7). The whole stock in the southern Horns Reef Area outside the 10 metre line, is regarded as collected in the 10—19 metres zone and the mean number per hour is calculated. In this calculation the proportion between the area of the depth zones outside the 20 metre line and the area of the depth zone 10—19 metres must be taken into account (see p. 8). We thereby obtain the values given in Table 20.

That the year classes older than 1919 are poorly represented both in 1922 and 1925, is probably due, as mentioned in the foregoing, to the fact that these year classes may be regarded as being the

[1] J. O. Borley and D. E. Thursby-Pelham: Report on the English Plaice Investigations in the North Sea during the Years 1921—1923. Ministry of Agric. and Fisheries. Fishery Invest. Series II. Vol. VII. No. 6. 1925. pp. 9 et seq.

Table 20. Numbers of plaice of the different age groups (year classes in brackets) caught per hour during the autumns of 1922 and 1925, the stock being regarded as concentrated within the 10—19 metre zone.

	0	I	II	III	IV	V	VI	VII
1922	288 (1922)	750 (1921)	920 (1920)	241 (1919)	46 (1918)	10 (1917)	1 (1916)	0 (1915)
1925	115 (1925)	137 (1924)	609 (1923)	964 (1922)	223 (1921)	195 (1920)	22 (1919)	0 (1918)
Proportion between the numbers for 1922 and 1925	2.5	5.5	1.5	0.3	0.2	0.1	0.0	—

remains of a larger stock which was reduced in numbers by intensive fishery on the nursery grounds during the years round about the close of the war. This circumstance limits to a great extent the value of the autumn fishing experiments for estimating the relative frequencies of the different year classes.

We can deduce from the numbers of age group III, which can only have been slightly reduced by fishing, that the year class 1922 was far more abundant than the 1919 year class. It may be taken for granted that age group IV in 1922, i. e. the 1918 year class, cannot have been so much reduced during its first two years of life by the intensive fishery which was still taking place in the south-eastern North Sea in 1919 — so destructive for the young fish — as to afford a complete explanation of the very great difference between the numbers of this age group in 1922 and its numbers in 1925, when it was the 1921 year class. We can therefore assume that the 1921 year class was scarcely less abundant than the 1918 year class. The age group II was not influenced by fishing and shows that 1923 produced a poorer year class than 1920.

The difference in numbers of the I-group are so great that the 1921 year class must be assumed to have been more abundant than the 1924 year class. The proportion between the numbers of plaice of the 0-group for the two years 1922 and 1925 is 2.5 : 1, which indicates a difference of the same nature between the year classes 1922 and 1925, but it cannot with certainty be established whether this is the case or not.

Moreover, the 0- and I-groups in 1925 are found to be about equally represented. This must necessarily mean that the 1925 year class was more abundant than the 1924 year class, in that we may expect to find more plaice of the I-group than of the 0-group in fishing experiments of this kind outside the 10 metre line.

The fact that the 1920 year class (II-group) was in 1922 represented about four times as profusely as the 1919 year class shows that the 1920 year class was more abundant than the 1919 year class.

The great difference in numbers between the plaice of the 1922 and 1921 year class (III- and IV-groups respectively) in the year 1925 suggests that 1922 produced a more abundant brood than 1921.

Since the age groups IV and V were represented in 1925 to about the same extent, we can deduce that the 1920 year class was more abundant than the 1921 year class.

Spring fishing experiments 1925 and 1927. The numbers of plaice of the different age groups caught per hour during the spring fishing experiments 1907, 1925, and 1927 between the 10 and 20 metre lines are given in Table 21.

In basing an estimation of the relative frequencies of the different year classes on the results of the spring fishing experiments, it must be borne in mind that at this season of the year only a small number of fishing experiments has been carried out and that the ensuing results are consequently less representative than those obtained from the autumn fishing experiments.

Table 21. Numbers of plaice of the different age groups (year classes in brackets) caught per hour in the Southern Horns Reef Area between the 10 and 20 metre lines in the springs of 1907, 1925, and 1927.

	I	II	III	IV	V	VI	VII	VIII
1907	14	64	64	14	1[1]			
1925	23 (1924)	107 (1923)	354 (1922)	147 (1921)	127 (1920)	29 (1919)	0 (1918)	0 (1917)
1927[2]	4 (1926)	206 (1925)	126 (1924)	198 (1923)	322 (1922)	18 (1921)	6 (1920)	3 (1919)
Proportion between the numbers for 1925 and 1927	6.0	0.5	2.8	0.7	0.3	1.6	0	0

It will be noted upon consulting Table 21 that the 1922 year class is predominant in 1925 as well as in 1927. This year class proved also in the autumn fishing experiments in 1922 and 1925 to be very abundant in the Southern Horns Reef Area.

Table 21 shows that the age group III was much more abundantly represented in 1925 than in 1927; the 1922 year class was thus considerably more abundant than the 1924; furthermore it is correspondingly clear from the way in which the age groups IV, V, and VI were represented in the springs of 1925 and 1927 respectively that the 1921 year class was less than or equal with the 1923 year class, that the 1920 year class was less numerous than the 1922 year class, and that the 1919 year class seems to have been more numerous than or equal with the 1921 year class.

Of the II-group were found in the spring of 1925 on an average only half of the number found in the spring of 1927 and we may reasonably deduce from this that the year 1923 has yielded a lower number of plaice than 1925. The fact that the I-group was represented in the catches of the fishing experiments in the spring of 1925 six times as numerously as in the spring of 1927 indicates that the 1924 year class was more abundant than the 1926 year class.

Moreover the spring fishing experiments in 1927 show that the year class 1922 has given many more plaice than 1921. It is interesting to notice that the 1923 year class, as IV-group, was represented by even 10 times more plaice than was the 1921 year class, as VI-group, which confirms the assumption that the 1923 year class was at least as abundant as the 1921 year class.

We know from the autumn fishing experiments that the 1923 year class was less than the 1920 year class. These two year classes are represented approximately equally in the spring fishing experiments of 1925, as II- and V-groups respectively, or 1923 is represented by slightly lower numbers than 1920. The proportion between the numbers of the II- and V-groups was in favour of the V-group still more in the spring of 1927 than in the spring of 1925, and we must therefore conclude that the year class which formed the V-group was also in the spring of 1927 (1922 year class) more numerous than the year class which formed the II-group (1925 year class), which was also indicated by the proportion between the frequencies of the 0-group in the autumns of 1922 and 1925.

If we continue our critical survey of the material afforded by age analyses of the stock in the southern Horns Reef Area outside the 10 metre line in order to throw light on the relations between the frequencies of the different year classes, it will merely confirm the results arrived at. These are, arranged in order in which the relations have been deduced in the foregoing, as follows:

[1] V+.

[2] For the sake of comparison the numbers of the age groups are altered to after April 1st by the addition of 1.

$1922 > 1919$	$1925 > 1924$	$1921 \leqq 1923$
$1921 \geqq 1918$	$1920 > 1919$	$1920 < 1922$
$1923 < 1920$	$1922 > 1921$	$1919 \geqq 1921$
$1921 > 1924$	$1920 > 1921$	$(1923 < 1925)$
$1922 > 1925$	$1922 > 1924$	$(1924 > 1926)$

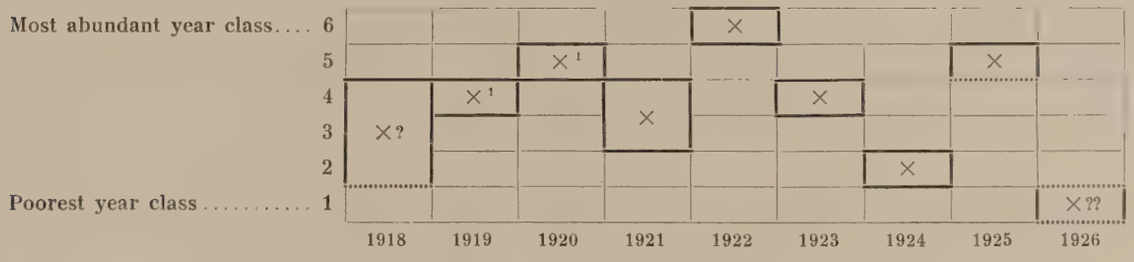
These results can be summarized as follows:

$$1922 \begin{Bmatrix} (> 1925) \\ > 1920 \end{Bmatrix} \left.\begin{matrix} > 1923 \\ > 1919 \end{matrix}\right\} \geqq 1921 \begin{Bmatrix} \geqq 1918 \\ > 1924\ (> 1926) \end{Bmatrix}$$

The relations whose determinations are uncertain are placed in brackets.

In the foregoing it has been pointed out (pp. 22—24) that the determination of the 1918 year class, by reason of the changes in the effect of fishing on the age composition of the stock, must be regarded as very uncertain. The 1919 and 1920 year classes may be assumed to have been more numerously represented in the different age groups than corresponds to the relative frequencies of the year classes and may therefore possibly have been placed too high in the summary above.

The results are given below in graphic form, where the frequencies of the different year classes are graded in 6 size classes, of which class 1 gives the least frequency and class 6 the greatest. Where one year class is depicted as extending over several frequency classes, this signifies that it belongs to one of these, but that it has not been possible to state definitely to which it belongs. The numerical difference between the different frequency classes is not indicated.



f. Comparison with results of other investigations on the relative frequencies of the different age groups and year classes in the North Sea during the period of years in question.

Investigations have been published on the relative frequencies of the different year classes in the North Sea during the period of years in question, based, partly on a determination of the quantity of eggs, partly on the relative frequencies of the 0- and I-groups, and partly on the age composition of the stock.

1) The quantity of eggs in the southern North Sea was determined by W. Mielck for the spawning period 1919—1920[2]. The quantity of eggs in this spawning period was shown to be from two to three times as great as during the years prior to the war in which investigations of this kind were carried out.

By comparing the quantity of eggs in the spawning period 1920—1921 in the Southern Bight of the North Sea with the quantity of eggs in this area in the periods 1910—1911 and 1913—1914, H. J. Buchanan-Wollaston[3] showed that the egg production in 1921 was about twice as great as in 1914, and between three and four times as great as in 1911.

[1] These classes are possibly placed too high in view of the changes in the intensity of fishing.

[2] W. Mielck: Bericht über die Untersuchungen der biologischen Anstalt auf Helgoland. Ber. d. Deutschen wiss. Komm. f. Meeresf. N. F. Bd. I. Hft. III. 1925. p. 29. — See also W. Mielck: Die Arbeiten der biologischen Anstalt auf Helgoland. Ber. d. Deutschen wiss. Komm. f. Meeresf. N. F. Bd. II. Hft. 4. 1926. pp. 17—19.

[3] H. J. Buchanan-Wollaston: Plaice-Egg Production in 1920—21, Treated as a Statistical Problem, with Comparison between the Data from 1911, 1914 and 1921. Ministry of Agricult. and Fisheries. Fishery Invest. Ser. II. Vol. IX. No. 2. 1926.

2) The relative frequency of the 0- and I-groups has been investigated for the stretch of water Fanø-Hanstholm by A. C. Johansen, who came to the result that the numbers of plaice of the 0-group both in 1920 and 1921 were of the same size category as in the years prior to the war [1]. In the inner corner of the German Bight there were found however in 1926 such large quantities of plaice of the 0-group, as to indicate that this area is much more important for plaice of the 0-group than the more northerly west coast of the Jutland peninsula [2].

An investigation of the numbers of the 0-group in the Horn Reef Area in the autumn of 1922 seems to show, according to Kirstine Smith, that the 1922 year class was comparatively far more abundant than the year classes 1903—05 [3].

In the America Dock at Cuxhaven Lübbert found a greater number of the first age group in 1922 than in 1925 and — as far as has been observed — also more than in the intervening period [4] and than in 1926 [5].

3) A. C. Johansen instituted in 1925 from the results of the fishing experiments of 1922 and 1925 a comparison between the relative frequencies of the various age groups, and has drawn conclusions as to the relative frequencies of the various year classes in this area [6]. He thus found that the year classes 1920, 1921, and 1922 were abundantly represented, 1923 being normally, 1924 less than normally, and 1925 probably less than normally represented, but for this latter year class fresh investigations were necessary.

As will be noticed, this agrees with the result arrived at previously from our systematic examination of the entire material from the fishing experiments of 1922, 1925, and 1927, with the exception that the year 1923, according to our investigation, must be characterized as having been at least as good as 1921 and that the year class 1925 seems to have been a rich one.

Kirstine Smith had already pointed out, on the basis of the fishing experiments in the Horns Reef Area in 1922, that it seemed as if the numbers of fry in 1920 and 1921 had been unusually great in comparison with the numbers in the years prior to the war [7].

As regards the south-eastern North Sea, Heincke and Bückmann investigated in 1926 the age composition of the stock in order to draw conclusions from it concerning the relative frequencies of the different year classes [8]. The 1919 and 1920 year classes in waters round the Heligoland proved to be relatively strongly represented in the catches from 1922 to 1925.

In 1927 Ad. Bückmann [9] continued this investigation by examining the figures of the catches for 1926 also, partly from the waters round Heligoland and partly to the west of it, N. of Norderney. This examination shows that the 1922 year class in the German Bight was extremely abundant, whereas the 1923 year class proved to be comparatively very scanty. North of Norderney the year class 1924 was shown by the fishing experiments in 1926 to possess a relatively great frequency.

Finally, D. E. Thursby-Pelham [10] investigated the age composition in order to estimate the relative

[1] A. C. Johansen: On the Density of the Young Plaice Population in the Eastern Part of the North Sea and the Skagerak in Pre War and in Post War Years. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. VI. No. 8. 1922. p. 13.

[2] Adolf Bückmann: Vorwiegen des Jahrgangs 1922 im Schollenbestande der Deutschen Bucht. Biological Statistics of the Stocks of Fish 1. Journal du Conseil. vol. II. No. 1. 1927. pp. 54 et seq.

[3] Kirstine Smith: On the Plaice Population of the Horns Reef Area in the Autumn of 1922. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. VII. No. 4. 1923. p. 10.

[4] H. Lübbert: Beobachtungen über der Plattfischbestand im Amerikahafen zu Cuxhafen im Jahre 1925. Ber. der Deutschen wiss. Komm. f. Meeresf. N. F. Bd. II. Hft. 4. 1926. p. 59.

[5] Adolf Bückmann, id. 1927. Footnote p. 68.

[6] A. C. Johansen in the Dansk Fiskeri Beretning for Aaret 1925 p. 99, and Journal du Conseil. Vol. 1. No. 1. 1926. p. 76.

[7] Kirstine Smith, id. 1923. p. 10.

[8] Fr. Heincke und Ad. Bückmann: Die Überfischung der Nordsee und die Wirkungen der Kriegsschonzeit auf ihren Schollenbestand. Der Fischerbote. XVIII Jahrgang. Hft. 3. 1926.

[9] Ad. Bückmann, id. 1927.

[10] D. E. Thursby-Pelham: Fluctuations in the Age Composition of the Plaice Stock in the Southern North Sea during the Period 1923 to 1926. Biological Statistics of the Stocks of Fish. III. Journal du Conseil. Vol. II. No. 2. 1927. pp. 173 et seq.

frequencies of the different year classes a) by fishing experiments on the Leman-Haaks line in May 1923—26, b) by fishing experiments in the vicinity of Vyl Lightship and Sylt, Graadyb and S. W. of Amrum near Heligoland in June and November 1926, and in some southern localities also in November 1926, c) by sampling the plaice landed in Lowestoft in October 1926.

These investigations showed that BÜCKMANN's results, as regards the great frequency of the 1922 year class and the low frequency, as compared with this, of the 1923 year class throughout the whole area dealt with, as also the great frequency of the 1924 year class to the west of Heligoland, held good also for the areas dealt with by English investigators.

The researches, carried out by German and English investigators, on the relative frequencies of the different year classes are thus supplemented by the Danish investigations showing that the 1924 year class in the southern Horns Reef Area only produced relatively few plaice (as pointed out by A. C. JOHANSEN in 1925), and determining somewhat more closely the relations between the frequencies of the different year classes.

One of the causes of the great frequency of the 1922 year class is probably the fact that the quantity of spawning plaice in the North Sea (cp. the Large and Medium categories of the catches made by the English steam trawlers (pp. 43—44) was still in 1922 greater than before the war (1913).

V. Growth of plaice and the size composition of the stock.

The following is an investigation of a) what changes have taken place during the years 1922, 1925, and 1927 in the average lengths of plaice of the different age groups in the southern Horns Reef Area outside the 10 metre line, and of b) what changes have taken place during these years in the size composition of the stock. This is followed by an investigation of c) what influence these changes have on the yield of the fishery. Finally the variation in average length from station to station is considered in relation to the variations in density.

a) Average lengths of the different age groups in the years 1922, 1925, and 1927.

Autumns 1922 and 1925. In Tables 22 and 23 are shown the average lengths of the various age groups, in which separate figures are given for males and females in the groups I—IV, for the autumn of 1922 and 1925 respectively, and in Fig. 10 is given a graphical presentment of the average lengths. Finally in Table 24 the difference is calculated between the average lengths of each age group in the autumns of 1925 and 1922. It will be noticed that in every age group except the V-group the average lengths were greater in 1925 than in 1922.

The difference in average length for the VI-group is not given in Table 24, since this age group was found in the fishing experiments of 1922 (cp. Table 8, p. 12) in too small numbers for the determination of the average length to be of any value.

Table 22. Average lengths of plaice of the different age groups in the southern Horns Reef Area outside the 10 metre line, autumn 1922.

Depth-zone	Mean depth m.	Number per Stat.	0	I			II			III			IV			V	VI	VII
			♂+♀	♂	♀	♂+♀	♂	♀	♂+♀	♂	♀	♂+♀	♂	♀	♂+♀			
10—19	15	678	6.0	11.4	11.4	11.4	13.5	14.1	13.8	16.9	17.3	17.2	19.9	21.0	20.6	27.2	—	—
20—29	24	672	6.8	12.2	12.1	12.2	14.5	14.5	14.5	18.1	19.0	18.6	21.3	22.1	21.8	25.1	22.0	—
30—39	32	226	—	14.1	14.1	14.1	15.6	15.6	15.6	20.4	20.1	20.3	22.4	21.6	22.0	24.9	23.0	23.0
>40	44	13	—	—	—	—	20.7	22.5	21.9	23.2	24.3	23.6	25.9	25.8	25.9	30.4	33.0	—

Table 23. Average lengths of plaice of the different age groups in the southern Horns Reef Area outside the 10 metre line, autumn 1925.

Depth-zone	Mean depth m.	Number per Stat.	0	I			II			III			IV			V	VI	VII
			♂+♀	♂	♀	♂+♀	♂	♀	♂+♀	♂	♀	♂+♀	♂	♀	♂+♀	♂+♀	♂+♀	♂+♀
10—19	15	374	6.9	12.7	13.2	12.9	16.4	16.7	16.5	18.7	19.0	18.8	22.4	23.0	22.7	25.7	23.7	—
20—29	25	723	8.2	13.2	13.0	13.2	16.5	16.5	16.5	19.2	19.1	19.1	23.6	25.0	24.3	26.3	27.9	25.0
30—39	32	372	—	15.0	—	15.0	18.1	18.6	18.3	20.2	20.8	20.4	23.8	24.2	23.9	25.6	28.9	—
> 40	49	49	—	—	—	—	22.5	24.3	23.6	24.4	25.3	24.8	25.6	27.0	26.3	28.1	30.6	—

Table 24. Increase in average length for each age group 0—V from the autumn of 1922 to the autumn of 1925 in the different depth zones.

Depth-zone	0	I			II			III			IV			V
	♂+♀	♂	♀	♂+♀	♂	♀	♂+♀	♂	♀	♂+♀	♂	♀	♂+♀	♂+♀
10—19	0.9	1.3	1.8	1.5	2.9	2.6	2.7	1.8	1.7	1.6	2.5	2.0	2.1	— 1.5
20—29	1.4	1.0	0.9	1.0	2.0	2.0	2.0	1.1	0.1	0.5	2.3	2.9	2.5	1.2
30—39	—	0.9	—	0.9	2.5	3.0	2.7	— 0.2	0.7	0.1	1.4	2.6	1.9	0.7
> 40	—	—	—	—	1.8	1.8	1.7	1.2	1.0	1.2	— 0.3	1.2	0.4	— 2.3

On account of the unequal distribution of plaice throughout the four depth zones into which the area is divided, and the general increase in the average lengths of the age groups as the depth increases, a comparison instituted in this way does not give us any direct information as to the difference in average length for the two years of the total number of plaice of one age group in the area under discussion.

The average length of plaice for each age group in the southern Horns Reef Area outside the 10 metre line is accordingly calculated in Table 25, the areas of the various depth zones being taken into account.

Table 25. Comparison between the average lengths of plaice for the various age groups (year classes in brackets) in the southern Horns Reef Area outside the 10 metre line in the autumns of 1922 and 1925.

	0	I	II	III	IV	V
1922	6.1 (1922)	12.0 (1921)	14.6 (1920)	19.4 (1919)	21.8 (1918)	26.0 (1917)
1925	7.1 (1925)	13.0 (1924)	16.8 (1923)	19.6 (1922)	24.2 (1921)	26.2 (1920)
Difference in average lengths 1925—1922	1.0	1.0	2.2	0.2	2.4	0.2

This result, with the exception of the III-group, agrees with the result of HEINCKE and BÜCKMANN's investigation of the average lengths of the various age groups in the waters round Heligoland. That no increase in the average length of the V-group took place during these years is explained chiefly by the circumstance that the 1925 V-group during its upgrowth was influenced by a greater density of stock than was the 1922 V-group[1]. That the average length of the III-group did not increase must doubtless

[1] See Fr. HEINCKE und AD. BÜCKMANN: Die Überfischung der Nordsee und die Wirkungen der Kriegsschonzeit auf ihren Schollenbestand. Der Fischerbote. XVIII. Jahrg. Heft 3, 1926. p. 88.

be ascribed to the circumstance that the 1922 year class, from which the III-group in 1925 was derived, was far more abundant than the 1919 year class, from which the III-group in 1922 was derived. The average length of an age group is, as will be shown on page 33, determined to a great extent by the frequency of the plaice of that year class to which the age group belongs.

The difference between the average lengths of an age group in 1925 and in 1922 can on an average be put at 1.5 cm.

Average length, spring and autumn 1925. A. C. Johansen has found [1] that whereas plaice of the I-group in the spring after April 1st have about the same average length as the 0-group in the foregoing months October—March, each of the older year classes in April—May is of often considerably greater length than the corresponding year classes in September—March. This is due to the circumstance that the relatively large plaice of I-, II-, and III-groups, which during the autumn and winter have populated the outer depth zones, migrate in the beginning of spring, in March and April, to the inner depth zones and crowd out the smaller fish of the same year classes.

A direct comparison between the average lengths of the various age groups in spring and autumn is however difficult by reason of the unequal distribution at these two seasons and the general increase in length as the depth increases. A better basis for comparison than is given by the material in its original form is the average lengths given in Table 26 for the stock of plaice of the different age groups throughout the whole area, the average lengths for the autumn and spring of 1925 being given in Tables 25 and 27, p. 32 respectively. The average lengths for the spring of 1925 are calculated as the average for the area between the 10 and 20 metre lines.

It will be observed that for every age group except I-gr. spring—0-gr. autumn and IV-gr. spring—III-gr. autumn, the average length was greater in autumn, contrary to what one would expect from previous experience. This may be explained by the increased rate of growth. That the average lengths of age groups 0 and III in the autumn of 1925 were less than the average lengths of age groups I and IV respectively in the spring of 1925 has a natural explanation in the fact that the year classes 1925 and 1922 were far more abundant than the year classes 1924 and 1921 respectively (cp. p. 33).

Average lengths, spring 1925 and spring 1927. In Tables 27 and 28 are shown the mean lengths of the different age groups at the separate stations, in the springs of 1925 and 1927 (figures for males and females being given for groups II—V).

It will be seen that just as in the case of the autumn experiments a closer comparison is not possible until the average lengths of the plaice have been calculated for the whole area. Since the plaice outside the 20 metre line are extremely scanty in comparation with those between the 10 and 20 metre lines, a calculation is made in Table 29, similar to the calculation of the relative numbers of plaice of the different age groups (Table 21 p. 26), of the average lengths of plaice in the area between

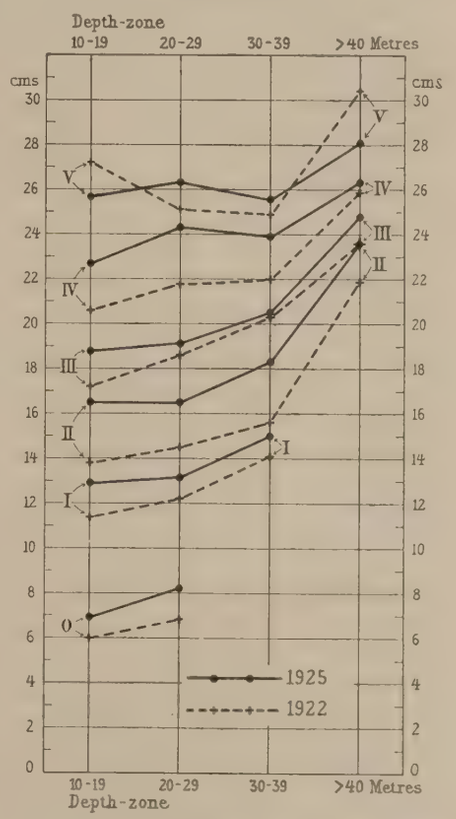


Fig. 10. Showing average length of the various age groups in the different depth zones of the southern Horns Reef Area in the autumns of 1922 and 1925.

[1] A. C. Johansen: Bericht über die dänischen Untersuchungen über die Schollenfischerei und den Schollenbestand in der östlichen Nordsee, dem Skagerak und dem nördlichen Kattegat. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. III. No. 8. 1910. p. 74.

the 10 and 20 metre lines, taking into account the number caught per hour at each station and assuming each station in this area to represent an equal part of it.

Table 26. Comparation between the average lengths of the different age groups (year classes in brackets), spring and autumn 1925 in the southern Horns Reef Area outside the 10 metre line.

Spring 1925 ...	Age group	I-gr.	II-gr.	III-gr.	IV-gr.	V-gr.	VI-gr.
	Year class	(1924)	(1923)	(1922)	(1921)	(1920)	(1919)
	Mean length	8.3	12.9	16.3	21.3	23.5	25.5
Autumn 1925..	Age group	0-gr.	I-gr.	II-gr.	III-gr.	IV-gr.	V-gr.
	Year class	(1925)	(1924)	(1923)	(1922)	(1921)	(1920)
	Mean length	7.1	13.0	16.8	19.6	24.2	26.2
Difference between average lengths, spring and autumn 1925		1.2	—0.1	—0.5	1.7	—0.7	—0.7

Table 27. Average lengths of the different age groups, spring 1925.

Depth m.	Stat. No.	Number per stat.	I	II			III			IV			V			VI
			♂+♀	♂	♀	♂+♀	♂	♀	♂+♀	♂	♀	♂+♀	♂	♀	♂+♀	♂+♀
10	3328	838	8.1	12,8	13,2	13.0	15.6	16.4	16.0	19.6	20.7	20.2	23.0	22.1	22.5	24.0
12	3320	162	—	11.5	14.0	12.1	13.9	15.8	14.6	19.2	16.0	18.6	16.0	20.0	18.0	—
13	3319	498	19.0	11.8	12.6	12.2	13.9	14.1	14.0	18.3	19.9	19.4	21.3	20.5	20.7	19.0
16	3321	198	—	13.2	12.8	13.0	14.7	16.3	15.3	21.0	20.3	20.6	21.5	23.4	22.9	23.5
18	3323	1484	8.3	11.7	12.8	12.2	15.5	17.2	16.2	20.7	21.1	20.9	22.7	22.2	22.4	23.0
20	3322	1574	—	17.0	16.0	16,7	18.0	18.4	18.2	21.9	23.2	22.4	24.2	25.0	24.6	26.3
25	3324	1	6.0	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 28. Average lengths of the different age groups, spring 1927[1].

Depth m.	Stat. No.	Number per stat.	I	II			III			IV			V			VI	VII	VIII
			♂+♀	♂	♀	♂+♀	♂	♀	♂+♀	♂	♀	♂+♀	♂	♀	♂+♀	♂+♀	♂+♀	♂+♀
10	3702	1418	7.5	14.7	14.7	14.7	19.8	20.5	20.1	22.9	22.7	22.8	23.7	24.5	24.1	25.0	30.0	—
12	3707	504	6.0	13.8	15.4	14.3	23.0	15.3	18.4	25.0	25.1	25.1	24.2	24.9	24.5	28.3	29.3	31.0
13	3704	3364	7.5	12.2	12.7	12.5	18.1	18.6	18.3	21.7	21.1	21.5	22.4	22.4	22.4	23.0	—	—
18	3705	4	—	—	—	—	—	—	—	—	—	—	25.0	—	—	—	—	—
18	3706	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	37.0	—

Table 29. Average lengths of plaice of the different age groups in the area between the 10 and 20 metre lines in the southern Horns Reef Area, in the springs of 1925 and 1927[1].

	I	II	III	IV	V	VI	VII	VIII
1925.....	8.3	12.9	16.3	21.3	23.5	25.5	—	—
1927.....	7.0	13.4	19.1	22.0	22.9	26.9	30.2	31.0
Difference between average length 1927—1925	— 1.3	0.5	2.8	0.7	— 0.6	1.4	—	—

[1] The fishing experiments in the spring of 1927 took place at the end of March and the age groups are, for the sake of comparison, given in the tables as one year older than at the time of capture.

From Table 21, p. 26 it will be seen that the I-, VII-, and VIII-age groups are represented in at least one of the years in so small numbers in the catches of the fishing experiments that only slight value can be attached to the determination of the average lengths of these age groups.

Table 29 shows that the average length of each age group was on the whole greater in 1927 than in 1925, but that the difference between the average lengths of the same age group in the two years varied greatly from age group to age group.

We can explain these variations in the differences between the average lengths of the same age group by comparing the differences in average length given in Table 29 with the mean numbers shown in Table 21, p. 26 of the plaice of each age group caught per hour in the springs of 1925 and 1927 within the area between the 10 and 20 metre lines. A graphic comparison of the relation between the numbers of the same age group for the two years with the difference in average lengths is shown in Fig. 11 for all the age groups for which the numbers of plaice caught at the fishing experiments are great enough for the average lengths to be determined with reasonable accuracy.

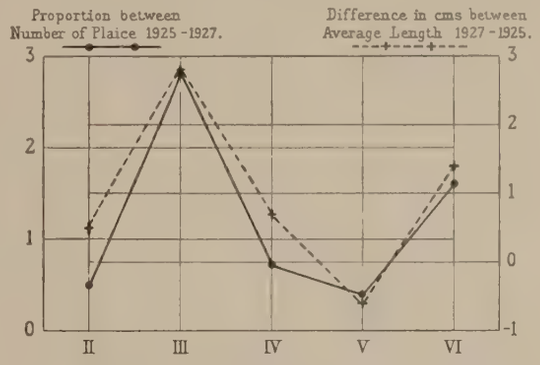


Fig. 11. Comparison of the relation between the numbers of the same age group for the springs of 1925 and 1927 with the difference in average lengths. Southern Horns Reef Area between the 10 and 20 metre lines.

We see that the difference between the average lengths of an age group is inversely proportional to the relation between the numbers of plaice of that age group. That the average length for the V-group was greatest in 1925 must thus be ascribed, at any rate partially, to the fact that the 1922 year class, which formed the V-group in 1927, was far more abundant than the 1920 year class, which formed the V-group in 1925.

The 1922 year class was characterized also at the fishing experiments in the autumn of 1922 by a very small average length. During the last years of the war and the first years after it, fishing had such an irregular effect on the stock of plaice that the relation between the numbers of plaice in the autumns of 1922 and 1925 cannot, as regards the age groups older than the III-group, be considered to give a quite true picture of the difference between the numbers of the original plaice of these older age groups. Furthermore, since the 0- and I-groups were only sparsely represented in the catches in the area investigated, it was not to be expected that a very close agreement should be found at the autumn fishing experiments of 1922 and 1925 between the difference in average length for each age group and the relation betveen the numbers of plaice.

The increase in average length from 1925 to 1927 can on an average be put at about 1 cm.

b) The size composition of the stock for the years 1922, 1925, and 1927.

From Tables 3, p. 6 and 7, p. 12, which show the numbers of plaice of the various size groups in the autumns of 1922 and 1925, and from Tables 1, p. 5 and 12, p. 15, which show the numbers within the various size groups in the springs of 1925 and 1927, it will be seen that in these years, parallel with the change in the age composition of the stock and moreover as a consequence of the increased lengths of each age group, a change has taken place in the size composition of the stock in such a way that the proportion of larger plaice has increased.

The change which has taken place can be seen, better than directly from these tables, if we think of the stock from the whole of the southern Horns Reef Area outside the 10 metre line as concentrated in the depth zone 10—19 metres and if we then calculate the mean numbers per hour's trawling in this area. As far as the spring is concerned, we can ignore the plaice found in the southern Horns Reef Area

outside the 20 metre line. These calculations will be found in Table 30, the areas of the various depth zones being taken into account where the autumn figures are concerned.

Table 30. Catches per hour, autumns 1922 and 1925, and springs 1925 and 1927, of plaice of the various size groups in the southern Horns Reef Area outside the 10 metre line; the stock being considered as concentrated in the area of the depth zone 10—19 m.

	4—9	10—14	15—19	20—24	25—29	30—34	35—39 cm.
Autumn 1922	323	1196	587	136	23	2	0
Autumn 1925	114	182	1035	603	298	32	0
Spring 1925	23	188	275	248	54	4	0
Spring 1927	3	178	182	362	145	11	1

It will be seen that from 1922 to 1925 there was an increase in the numbers of plaice in all size groups over 15 cm. and from 1925 to 1927 in all size groups over 20 cm., whilst the numbers of plaice in the size groups under 15 cm. and under 20 cm. respectively have diminished.

The numbers and distribution of plaice above the Danish minimum length for export plaice, 22.5 cm.[1], which have been caught in post-war years at fishing experiments, are given in the tables below, of which Tables 31 and 32 show the numbers and distribution of plaice over 22.5 cm., caught in the autumns of 1922 and 1925 respectively, and Tables 33 and 34 the corresponding numbers for the springs of 1925 and 1927.

Table 31. Numbers (in brackets, percentages) of plaice over 22.5 cm. of the various age groups caught per hour in the southern Horns Reef Area outside the 10 metre line, autumn 1922.

Depth-zone m.	II	III	IV	V	VI	Total
10—19	0	1 (2)	2 (17)	1 (100)	0	4
20—29	0	4 (7)	2 (42)	1 (60)	0 (33)	7
30—39	1 (1)	11 (13)	6 (28)	4 (67)	0 (33)	22
> 40	1 (17)	7 (57)	4 (94)	2 (100)	1 (100)	15

Table 32. Numbers (in brackets, percentages) of plaice over 22.5 cm. of the various age groups caught per hour in the southern Horns Reef Area outside the 10 metre line, autumn 1925.

Depth-zone m.	II	III	IV	V	VI	Total
10—19	1 (1)	8 (7)	6 (51)	8 (91)	1 (100)	24
20—29	2 (1)	38 (12)	44 (74)	51 (89)	7 (94)	142
30—39	2 (4)	34 (17)	52 (75)	42 (90)	5 (100)	136
> 40	1 (80)	14 (81)	13 (97)	15 (100)	2 (100)	44

[1] The size limit, 22.5 cm., is in force from October 1st to February 28th (29th), for the rest of the year it is 24.0 cm.

Table 33. Numbers (in brackets, percentages) of plaice over 22.5 cm. of the various age groups caught per hour, spring 1925.

Depth m.	Stat. No.	II	III	IV	V	VI	Total
10	3328	0 (0)	4 (1)	20 (19)	20 (53)	4 (100)	48
12	3320	0 (0)	0 (0)	2 (20)	0 (0)	0	2
13	3319	0 (0)	1 (0)	4 (9)	2 (14)	0 (0)	7
16	3321	0 (0)	0 (0)	4 (12)	16 (57)	12 (55)	32
18	3323	0 (0)	16 (3)	50 (16)	142 (43)	6 (30)	214
20	3322	0 (0)	7 (1)	125 (34)	184 (53)	96 (75)	413
Average catch per hour between the 10 and 20 metre lines	....	0	5	34	61	20	109

Table 34. Numbers (in brackets, percentages) of plaice over 22.5 cm. of the various age groups[1] caught per hour, spring 1927.

Depth m.	Stat. No.	II	III	IV	V	VI	VII	VIII	Total
10	3702	0 (0)	56 (16)	184 (53)	180 (72)	10 (100)	4 (100)	0	434
12	3707	0 (0)	4 (20)	40 (71)	168 (71)	84 (100)	28 (100)	16 (100)	340
13	3704	0 (0)	16 (4)	228 (28)	724 (48)	16 (100)	0	0	984
18	3705	0	0	0	4 (100)	0	0	0	4
18	3706	0	0	0	0	0	4 (100)	0	4
Average catch per hour between the 10 and 20 metre lines	....	0	13	75	179	18	6	3	298

By comparing Tables 31 and 32, it will be seen that the numbers of plaice above the export minimum increased very considerably between the years 1922 and 1925; if we calculate the total number per hour in the area under discussion, taking into account the unequal areas of the different depth zones, we find that the number of export plaice in 1925 was eight times as large as in 1922. By comparing Tables 33 and 34 in which, in addition to the numbers of plaice over 22.5 cm. caught at the different stations, also the mean catches per hour in the area between the 10 and 20 metre lines are calculated, it will be seen that the total number of plaice above the export minimum was more than twice as large in the spring of 1927 as in the spring of 1925.

If we examine the changes which have taken place in the number of plaice above the minimum for the Danish market (25.7 cm.), we shall see still more clearly this increase in the number of large plaice. In Tables 35 and 36 are given the numbers of plaice over 25.7 cm. caught per hour in the autumns of 1922 and 1925 respectively in the southern Horns Reef Area outside the 10 metre line, and in Table 37 are given the numbers of plaice over 25.7 cm. caught per hour in the southern Horns Reef Area between the 10 and 20 metre lines in the springs of 1925 and 1927.

We see that there was a very great increase in the numbers of these plaice from autumn 1922 to autumn 1925, and that the numbers from spring 1925 to spring 1927 also increased considerably.

Of plaice over 33 cm. in length, in the autumn of 1922 at each of two stations (depths 19 and 32 metres) 1 was caught per hour, and in the autumn of 1925 at each of three stations (depths 25, 32, and 50 metres) 2 were caught per hour. All belonged to the V-group, except one of the VI-group caught in 1925. In the spring of 1925 there were caught per hour at one station 9 specimens over 33 cm. in length (all

[1] For the sake of comparison with the results of the fishing experiments in the spring of 1925, the age groups are given as one year older than when taken at the fishing experiments (end of March).

of the VI-group) and in the spring of 1927 were caught per hour at one station 8 (after April 1st of VII-group). The numbers of plaice over 33 cm. thus similarly increased from autumn 1922 to autumn 1925, but on the other hand not from spring 1925 to spring 1927.

Table 35. Numbers of plaice over 25.7 cm. caught per hour in the southern Horns Reef Area in the different depth zones, autumn 1922[1].

Depth-zone m.	II	III	IV	V	VI
10—19	0	0.2	0.3	0.5	0
20—29	0	0.6	0.1	0.3	0.1
30—39	0.1	2	2	2	0
> 40	0.1	2	1	0.8	0.2

Table 36. Numbers of plaice over 25.7 cm. caught per hour in the southern Horns Reef Area in the different depth zones, autumn 1925[1].

Depth-zone m.	II	III	IV	V	VI
10—19	0	2	2	6	0
20—29	0.4	5	19	31	5
30—39	0	4	16	25	4
> 40	0.3	6	8	15	2

Table 37. Numbers of plaice over 25.7 cm. of the different age groups caught per hour in the southern Horns Reef Area between the 10 and 20 metre lines in the springs of 1925 and 1927[2].

	II	III	IV	V	VI	VII	VIII	Total
1925	0	2	8	28	17	0	0	55
1927	0	2	42	66	13	6	3	132

c) The yield by weight of the fishery compared with the size composition of the stock.

On the basis of the changes in the size composition of the stock which have been the subject of investigation in the foregoing, it is of special interest to investigate:

1) how the yield by weight of the fishery has been influenced by the varying composition of the stock,

2) whether it is possible, on the basis of the composition of a stock, to estimate the prospects for the yield by weight of the fishery for the following years.

The plaice fishery from Esbjerg was before the war carried on almost exclusively in the Horns Reef Area, but since the war more remote grounds have also been fished to a considerable extent.

During the years subsequent to the war, various circumstances have affected the intensity of the plaice fishery, namely the uncertain marketing conditions prevailing during the first years after the war and the fact that from 1916 a haddock fishery was started concurrently with the plaice fishery.

Table 38. Yield in metric tons of the plaice landings in Esbjerg from the sea fishery.

Year	Plaice in metric tons	Year	Plaice in metric tons	Year	Plaice in metric tons
1919	4861	1922	2527	1925	9094
1920	3445	1923	3488	1926	9825
1921	1333	1924	3798	1927	Presumably about 10—25 % lower than in 1926.[3]

The low catches of plaice in the years 1919—1922 were due to bad marketing conditions. The increase in the yield which took place from 1921 to 1922 was due, according to the *Fiskeri Beretning*, not

[1] Numbers less than one are given as fractions.

[2] For the sake of comparison each age group in 1927 is altered to after April 1st, i. e. by the addition of 1 to its number

[3] These figures have been kindly supplied by A. C. Strubergb M. sc., of the Fishery Board.

so much to an improvement in the stock as to the beginning of an improvement in marketing conditions. In 1923 the *Fiskeri Beretning* mentions that the plaice were found far out to sea and very much dispersed, but in 1924 the stock was fairly dense and in 1925 the stock of young fish close inshore was great.

Plaice become marketable after attaining a length of 22.5—25.7 cm., and as the difference in length from age group to age group of plaice of 15—20 cm. in length in 1922 (II-, III-, and IV-groups) was about 3 cm., in 1925 (I-, II-, III-, and IV-groups) $3^1/_2$—4 cm., and in 1927 (I-, II-, and III-groups) about 4 cm. ($3^1/_2$—$4^1/_2$ cm.), we can with the aid of Table 30, p. 34 in connection with Tables 31—34, pp. 34—35 and Tables 35—37, p. 36, compare to some extent the composition of the stock of marketable plaice even in years when no fishing experiments have taken place.

We have seen in the foregoing that the stock from a commercial point of view was of very little value at the close of the 1922 fishing season, but was particularly favourable at the close of the 1925 season.

Since during the winter months only a very slight growth takes place, the spring fishing experiments of 1925 and 1927 show that the composition of the stock at the close of the 1926 fishing season was considerably more favourable than at the close of the 1924 season.

By comparing the stock in the springs of 1925 and 1927 in order to determine its value for the fishery in these two years, it will be seen that plaice, of the lengths from which the plaice for the home market are recruited, — according to the growth rate prevailing during these years — were about the same in number in the two springs of 1925 and 1927. It will also be seen that plaice, of the lengths from which the export plaice are recruited, were present in smaller numbers in the spring of 1927 than in that of 1925, whilst in the beginning of 1927 was found a stock of export plaice and plaice for the home market which was over double as great as at the beginning of 1925 (cp. Tables 33, 34, p. 35, and 37, p. 36). It may therefore be asumed that the value of the stock from a commercial point of view was more or less the same in 1925 as in 1927.

These changes in the commercial composition of the plaice stock are in accordance with the changes in the yield of the fishery (cp. Table 38).

The prospects for 1928 differ from those for 1926 (estimated from the composition of the stock in the springs of 1927 and 1925 respectively). Marketable plaice will be recruited in the course of 1928 in somewhat less number than in 1926, but on the other hand the stock of marketable plaice will be found at the beginning of 1928 to be a little larger than at the beginning of 1926.

In 1927 the stock of marketable plaice was recruited from the plaice which in the spring of 1925 were about 15 cm. in length, and correspondingly in 1929 it will be recruited from those which in the spring of 1927 were about the same length, or rather slightly less. By consulting Table 30 we find that recruiting will be less in 1929 than it was in 1927. At the same time the stock of older plaice which will be in existence at the beginning of 1929, will probably be less than that which was in existence at the beginning of 1927.

d) The dependence of the average length on the density of the stock at the different localities.

If for the summer of 1925 we compare the average lengths of the different age groups at each station with the numbers of plaice caught per hour at that station, as has been done in Figs. 12 and 13, we shall se that the average length of each age group, when we consider localities of about the same depth, varies inversely with the number of plaice at the locality in question. This holds good of course only when the age group is represented in sufficient numbers at the depth in question for its average length to be regarded as determined with so great accuracy that chance errors are considerably less than the variations from station to station.

This circumstance that the average length tends to vary from locality to locality in inverse proportion to the density of the stock can, in consideration of the size of the variations in average length from station to station, scarcely be explained otherwise than by the assumption that the stock which is

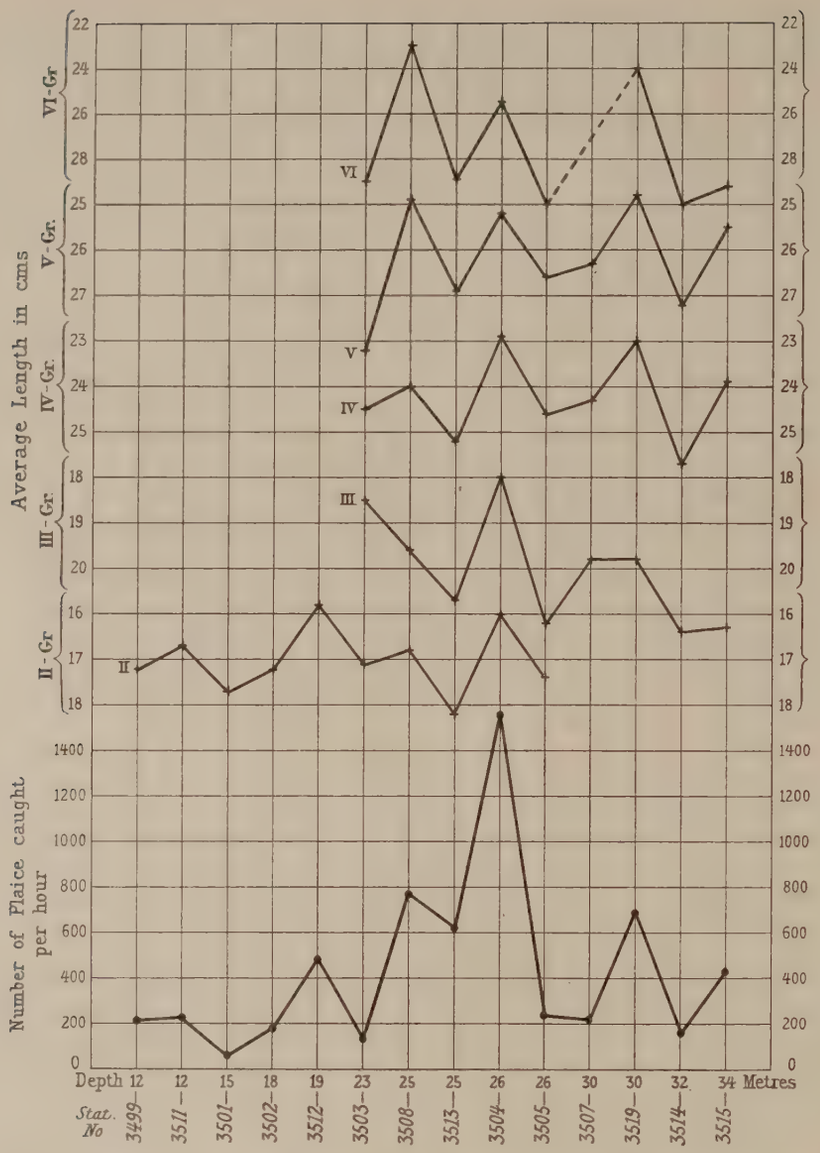


Fig. 12. Comparison of average lengths of the various age groups at each station in the southern Horns Reef Area between the 10 and 40 metre lines with numbers of plaice caught per hour at that station. Autumn 1925.

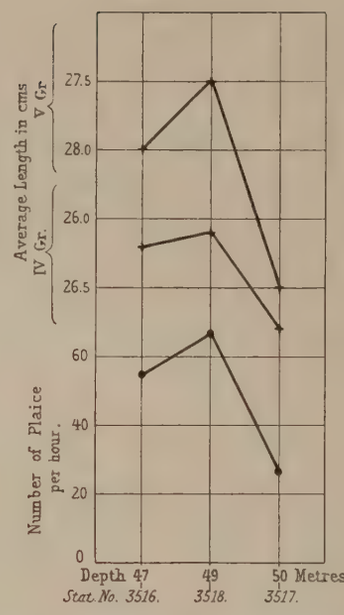


Fig. 13. Comparison of average lengths of the various age groups at each station in the southern Horns Reef Area outside the 40 metre line with numbers of plaice caught per hour at that station. Autumn 1925.

found in one locality has throughout the summer consisted in the main of the same plaice and has maintained approximately the same density. This is in accordance with the fact that plaice seem to migrate in shoals throughout the summer, which A. C. JOHANSEN has pointed out on the basis of the marking experiments [1].

The only factor which can cause the average length to vary from locality to locality in inverse proportion to the density of the stock is namely the competition for food during the summer growth. A spontaneous splitting up of the plaice of each age group so that the largest individuals in it seek the most thinly populated regions whilst the smaller seek the most densely populated, is improbable seeing that the largest individuals of one age group may be regarded as biologically closely resembling the smaller individuals in the following age group.

In the spring of 1925 (cp. Table 1, p. 5 and Table 27, p. 32) no connection is apparent between

[1] A. C. JOHANSEN: Contributions to the Biology of the Plaice etc. II. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. II. No. 5. 1907. pp. 89—91.

the variations in average length and the density from locality to locality, nor it is to be expected after the concentration of plaice, which takes place in the course of the autumn and winter, and the intermingling of the different shoals which must necessarily be a consequence of it.

We see in Figs. 12 and 13 that the variations in average length from locality to locality depend not so much on the numbers of the plaice in these localities as on the proportion between the numbers and the general distribution of density according to depth, where the density as a whole decreases from the 20—29 metres' zone in both directions, i. e. out to sea and towards the coast (cp. Charts fig. 3 and 4, pp. 8 and 9). In the outer depth zone over 40 metres (Fig. 13), where the number of individuals is very low in proportion to the numbers in the inner depth zones, the interdependance of the variations in the relative numbers and the average lengths of the plaice from locality to locality appears to be just as great as in the depth zone 20—29 metres. Competition within the separate parts of the stock (the separate shoals) thus seems to affect the average length in that part of the stock where the density on the whole is great just as much as where it on the whole is slight.

VI. Relative frequency of males and females.

a) Autumns 1922 and 1925. In Tables 39 and 40 are shown the percentages of females of age groups II—VI in the different depth zones in the autumns of 1922 and 1925 respectively.

Table 39. Percentages of females and (in brackets) numbers of plaice of age groups II—VI caught per hour in the southern Horns Reef Area outside the 10 metre line, autumn 1922.

Depth-zone m.	II	III	IV	V	VI
10—19	56 (168)	65 (37)	65 (12)	100 (1)	—
20—29	48 (324)	57 (56)	62 (5)	38 (1)	0 (0)
30—39	46 (98)	45 (83)	51 (21)	38 (5)	0 (1)
> 40	25 (4)	33 (6)	35 (2)	83 (1)	—

Table 40. Percentages of females and (in brackets) numbers of plaice of age groups II—VI caught per hour in the southern Horns Reef Area outside the 10 metre line, autumn 1925.

Depth-zone m.	II	III	IV	V	VI
10—19	47 (93)	49 (112)	46 (13)	61 (9)	33 (1)
20—29	41 (233)	53 (313)	54 (60)	65 (57)	44 (7)
30—39	36 (47)	36 (199)	43 (70)	46 (48)	35 (4)
> 40	60 (2)	43 (18)	53 (13)	53 (16)	40 (2)

We notice, as regards the distribution both in the autumn of 1922 and in that of 1925, the fact noted during previous investigations in this region that the percentage of females decreases with the depth and in each depth zone increases with the age. [1]

The decrease in the percentage of females with increasing depth which was so marked in the

[1] Kirstine Smith, id. 1923.

autumn of 1922 was however far less noticeable in the autumn of 1925. It was in autumn 1925 as in autumn 1922 just as marked in the case of age group II, of which no plaice are mature and none attain the minimum length for fishing, as in the older age groups, which circumstance was certainly due, as KIRSTINE SMITH has pointed out, to a feature in the biology of plaice which is independent of fishing and the state of maturity (cf. p. 18).

b) Springs 1925 and 1927. Fishing experiments in the springs of 1925 and 1927 showed, with reference to the distribution of the relative numbers of females, the same increase with age as shown by the autumn fishing experiments. In Tables 41 and 42 are shown the percentages of females found at the spring fishing experiments.

Table 41. Percentages of females and (in brackets) the numbers of plaice of age groups II—VI caught per hour in the southern Horns Reef Area outside the 10 metre line, spring 1925.

Depth m.	Stat. No.	II	III	IV	V	VI
10	3328	58 (198)	56 (406)	56 (108)	58 (38)	50 (4)
12	3320	27 (30)	37 (118)	20 (10)	50 (4)	—
13	3319	56 (84)	51 (343)	74 (46)	79 (14)	100 (1)
16	3321	31 (26)	41 (88)	59 (34)	71 (28)	27 (22)
18	3323	38 (250)	36 (502)	60 (318)	49 (332)	33 (20)
20	3322	33 (55)	41 (668)	40 (366)	47 (347)	57 (128)

Table 42. Percentages of females and (in brackets) numbers of plaice of age groups II—VI[1] caught per hour in the southern Horns Reef Area outside the 10 metre line, spring 1927.

Depth m.	Stat. No.	II	III	IV	V	VI
10	3702	26 (452)	42 (346)	38 (346)	56 (250)	50 (10)
12	3707	33 (60)	60 (20)	57 (56)	41 (236)	52 (84)
13	3704	61 (724)	43 (388)	41 (784)	51 (1444)	0 (16)
18	3705	—	—	—	100 (4)	—

c) Changes in the relative numbers of males and females from 1922 to 1927. It is a well known fact that the relative number of females in a stock of plaice, which is untouched by fishing is less than in a stock which is being fished. In accordance with this, the percentage of females in the autumn of 1922 in the southern Horns Reef Area decreased greatly out towards the central North Sea, where the stock had been protected during the war and where remnants of it were still found in 1922. The last remnants of this protected stock may be considered to have disappeared in 1923 and in 1925 in accordance with this the percentage of females was increased in the outermost depth zone.

The changes however in the relative frequencies of males and females are due alone, as KIRSTINE SMITH has pointed out[2], to be a change in the local distribution of males and females.

With a view to investigating the question of changes in the relative number of females in the entire stock in the area dealt with, the average percentages have been calculated, in Table 43 below, of females in the springs of 1925 and 1927 in the area between the 10 and 20 metre lines, whilst for the

[1] For comparison with the results of the fishing experiments in the spring of 1925 the number of each age group is altered to after April 1st by the addition of 1.

[2] KIRSTINE SMITH, id. 1923. pp. 21—22.

autumns of 1922 and 1925 the stock has first been regarded as concentrated in the 10—19 metre's zone, taking into account the areas of the different depth zones, and the relative frequencies of the females on the entire stock have then been calulated accordingly.

Table 43. Percentages of females in the entire stock in the southern Horns Reef Area outside the 10 metre line.

	I	II	III	IV	V	VI
Autumn 1922	55	47	47	46	40	—
— 1925	32	42	49	40	50	32
Spring 1925.....	—	45	44	51	50	32
— 1927[1].....	57	59	50	56	44	50

It will be seen that the percentages of females throughout the whole area in question was approximately the same in 1922 as in 1925[2], but increased from 1925 to 1927 in the case of the younger age groups. The latter were however so poorly represented at the fishing experiments, and particularly so in 1927, that no importance can be attached to the changes found.

VII. Changes in the stock of plaice after the partial protection caused by the war.

The changes in the plaice stock in the Horns Reef Area during the war and the first years after the war are closely discussed and explained in the works of A. C. Johansen and Kirstine Smith.

In the following we shall consider the changes in recent years in connection with the changes in the first years after the war and with the changes in the other parts of the North Sea which have been the subject of German and English investigations.

These investigations together cover the nursery grounds in the southern and south-eastern North Sea, since the German investigations furnish information as to the stock in the waters round Heligoland, and the English investigations especially as to the stock in the south-western area of the nursery grounds.

Moreover, the English investigations in particular cover the stock in the open North Sea.

The investigators have concerned themselves chiefly with the changes in the numbers of the stock, the age composition and growth, but also with the distribution of the stock, the relative frequencies of the two sexes and finally with the effect of the changes on the yield of the fishery.

Changes in the plaice stock up to 1922[3]. The results of earlier Danish investigations can, as regards the growth and numbers of plaice, be summarized as follows.

Plaice over 30 and 33 cm. constituted (in May) the following percentages of the fish over 27 cm. in length landed in Esbjerg.

	1904—06	1916	1919
over 30 cm.	23 %	40 %	54 %
over 33 cm.	3 %	10 %	23 %

The numbers of smaller plaice (below 27 cm. in length) in the catches seem to have been unchanged.

The density of the stock in those areas where marketable plaice predominated, was thus greater in 1919—20 than in 1916 and greater in 1916 than in 1904—06.

[1] For the sake of comparison the number of each age group is altered to after April 1rst by the addition of 1.

[2] cp. Kirstine Smith, id. p. 22.

[3] A. C. Johansen and Kirstine Smith: Investigations as to the effect of the restriction of fishing during the war on the plaice of the eastern North Sea. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. V. No. 9. 1919. — Kirstine Smith: Danish Investigations of Plaice from the North Sea. July 1919—July 1920. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. VI. No. 2. 1921. — Kirstine Smith: On the Plaice Population of the Horns Reef Area in the Autumn of 1922. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. VII. No. 4. 1923.

Whilst the density thus increased after the years prior to the war, the rate of growth correspondingly diminished.

The numbers of older plaice were therefore very greatly augmented during the war.

At the fishing experiments with trawl in the autumn of 1922, the numbers of large plaice (over 30 cm. in length) proved to have diminished since 1919—20; in particular the plaice 35—40 cm. in length which had been found in great numbers in 1919 had now become relatively scarce. Plaice under 27 cm. were on the other hand approximately twice as numerous as in 1919 and more than twice as numerous as in the years 1904—05. In particular, the I- and II-groups were more numerous than in the years 1903—07.

The average length for the II-, III- and IV-groups was in the southern Horns Reef Area about 4 cm. less than in 1905 and 1907, and the small lengths were probably due chiefly to the rate of growth in 1921 and 1922 being abnormally slow.

Changes in the plaice stock after 1922. The most important changes in the plaice stock after 1922 have been, as shown by the fishing experiments in the spring and autumn of 1925 and in the spring of 1927, the decrease of the total stock in the entire southern Horns Reef Area from the coast to Long. 6° E. from 1922 to 1925 and its decrease again from 1925 to 1927. It must however be borne in mind that the spring fishing experiments do not give wholly comparable values from year to year for the numbers of the youngest age groups. The stock is still somewhat larger than before the war. In the southern Horns Reef Area outside the 10 metre line the total stock was about the same for the three years in question, but the proportion of older plaice in the composition of the stock increased greatly during these years.

The abundant year classes 1920 and 1921 were succeeded, as Kirstine Smith pointed out in 1923, by a still more abundant year class 1922, and since 1922 these year classes have predominated in the numbers of the stock in the southern Horns Reef Area outside the 10 metre line.

As the total stock diminished, the rate of growth correspondingly increased in the case of the age groups 0—IV, and their average lengths regained in the years 1922—1927 about two thirds of what they had lost during the war. But at the same time it is noticeable that the numbers of a single year class determine to a considerable extent its rate of growth, since the growth rate of an abundant year class is comparatively small, whilst it is greater for a poor year class.

In contradistinction to the other age groups, for which it has been possible to determine the average lengths with considerable accuracy, the V-group shows a diminution in length from 1925 to 1927. A partial explanation of this is afforded by the circumstance that the V-group in 1927 consisted of the unusually abundant year class 1922, but it must at the same time be noted that the main area of distribution of the V-group lies outside the nursery grounds, where there have been other conditions affecting growth (see below).

Comparison between the changes in the Horns Reef Area and the other parts of the nursery grounds in the southern and south-eastern North Sea.

The investigations on the plaice stock in the waters round Heligoland, carried out by Heincke and Bückmann [1] showed that for the males the age groups I—IV, and for the females the age groups I—V, decreased in average length from before the war (1905—06) until 1916, again in the period 1916—19, and again from 1919 until 1922. The V- and VI-groups of the males and the VI-group of the females, on the other hand, only decreased up to 1919 after which year they increased in average length until 1922. From 1922 to 1925 they again decreased in average length. The different age groups in this area thus show after 1922 the same variation as the corresponding age groups in the Horns Reef Area. (The changes in average length during the years 1919—1922 are not known from the Horns Reef Area). These

[1] Fr. Heincke und Ad. Bückmann, id. 1926.

changes are ascribed by HEINCKE and BÜCKMANN to changes in the density of the stock. With the steadily increasing numbers of young plaice of year classes 1920, 1921 and 1922 the density of the stock in the nursery grounds increased up to about 1923, which created steadily deteriorating conditions up to this date for the growth of the plaice. The changes in the period from 1922 to 1925 are to be explained in this region, as in the Horns Reef Area, by the again diminishing density of the plaice stock.

Investigations of the plaice stock on the Leman-Haaks line (in May) show, according to BORLEY and THURSBY-PELHAM [1], that the growth rate for age groups III, IV, and V, except for the males of the III-group, increased from 1920 to 1922 and even to 1923, but that from then to 1924 the average lengths of the different age groups decreased.

The changes in the average lengths of the different age groups thus correspond to those observed for the V- and VI-groups in the waters round Heligoland, and when the changes in the Leman-Haaks Area are found in the age groups III, IV, and V (the fishing experiments in this area took place in May, i. e. at the beginning of the summer growth of the age groups under discussion) this must presumably be explained by the fact that the Leman-Haaks Area is situated in the direct vicinity of the important spawning grounds and that the stock there consequently is influenced to a considerable extent by the stock in the open North Sea. The quantity of plaice in the open North Sea decreased up to the year 1923, but seems to have increased after that date (cp. p. 44). One would expect a corresponding increase in the growth rate up to 1923 and a corresponding decrease after that date, as has been found by BORLEY to be the case in the Leman-Haaks Area.

The relative frequencies of the different year classes in the Horns Reef Area are shown on page 27. The investigations undertaken there in conjunction with those of BÜCKMANN [2] and THURSBY-PELHAM [3] show that the 1922 year class throughout the entire nursery grounds for young plaice was very abundantly represented. The 1921 year class in the Leman-Haaks Area seems to have been very abundant, whilst that in the Horns Reef Area must be characterized as above normal, although it produced less plaice than 1920 and less than or the same as 1919. The 1923 year class has in every area been far more sparse than the 1922 year class. The 1924 year class was very plentiful off Ymuiden, on the Leman-Haaks line and the north of Norderney, but was very sparse on the other hand off Heligoland and in the Horns Reef Area in comparison with the other year classes. The 1925 year class in the southern Horns Reef Area seems to have been very rich, yet poorer than the 1922 year class.

Relation between the changes in the stock in the nursery grounds and in the open North Sea.

The fullest information concerning the changes in the stock in the open North Sea has been published by English investigators. Few age analyses have been given but the information concerning the fluctuating size composition of the stock is varied and based in some cases on very extensive data. Of particular interest is an investigation on the proportions in the catches of the different trade categories. In Table 44, below, are given the proportions in the catches of English steam trawlers, calculated from the tables published by BORLEY and THURSBY-PELHAM [4] and by GARSTANG [5].

There is no doubt whatever that the great increase in the quantities of the trade categories Large and Medium from 1913 to 1919 was a result of the protection afforded the North Sea, and in particular the central parts of it, during the years of the war. During this period a stock of large plaice accumul-

[1] J. O. BORLEY and D. E. THURSBY-PELHAM, id. 1925.

[2] ADOLF BÜCKMANN: Vorwiegen des Jahrgangs 1922 im Schollenbestande der Deutschen Bucht. Biological Statistics of the Stocks of Fisch, I. Journal du Conseil. Vol. II. No. 1. 1927. p. 54.

[3] D. E. THURSBY-PELHAM: Fluctuations in the Age Composition of the Plaice Stock in the Southern North Sea during the Period 1923 to 1926. Biological Statistics of the Stocks of Fish, III. Journal du Conseil. Vol. II. No. 2. 1927. pp. 173 et seq.

[4] J. O. BORLEY and D. E. THURSBY-PELHAM, id. 1925. pp. 11 and 77.

[5] W. GARSTANG: Plaice in the North Sea. The Times 21—26 April, 1926.

ated, which offered exceptionally favourable opportunities for fishing, when the latter resumed its pre-war proportions. As the table shows, their quantity was reduced from year to year. It is noteworthy that the quantities of Large and Medium plaice were in the abundant spawning years 1919, 1920, 1921 and 1922 greater than in 1913.

Table 44. Catch of plaice (cwt.) of the different trade categories in North Sea per day's absence of English steam trawlers. [1]

Year	Large	Medium	Small	Total
1913	0.42	0.68	0.90	2.09
1919	1.71	2.46	0.34	4.53
1920	1.40	1.29	0.51	3.42
1921	0.67	1.20	0.62	2.57
1922	0.41	0.84	0.91	2.21
1923	0.27	0.51	1.05	1.90
1924	0.21	0.52	1.36	2.1

It is on the other hand rather difficult to explain the decrease from 1913 to 1919 in the quantities of the trade category Small. Borley and Thursby-Pelham have shown that these plaice during the years 1920—1923 seem to have gradually spread out over the North Sea from the south-eastern nursery grounds. At each locality in the southern part of the North Sea where English trawl fishery took place, the quantity of small plaice caught per 100 hours' fishing was increased from year to year.

W. Garstang has put forward the hypothesis, based on the above and on the investigations, mentioned on pp. 18 et seq., on the changes in the distance from the coasts of the centres of gravity of the different age groups on the Leman-Haaks line, that the decrease in numbers of small plaice was due to the accumulated stock, the large plaice in the competition for food banking up the small plaice in the shallower parts of the inshore waters where starvation and accordingly death prevailed. Not until the accumulated stock had been gradually depleted by fishing could, according to Garstang, more plaice from the nursery grounds join the stock in the open North Sea [2].

The material relative to the plaice of the different trade categories, dealt with by Borley and Thurshy-Pelham, does not however, as the latter themselves observe, give any indication that the small plaice in 1919 were present in great abundance near the continental coast [3], and as we have seen on pp. 19—20 there is no reason to assume that the plaice in the Horns Reef Area were banked up near the coast. This was possibly a purely local phenomenon in the south-western North Sea.

The changes in the frequency of the trade category Small in the catches of the English steam trawlers can apparently be ascribed to the following: a) changes in the rate of growth, b) changes in the situation of the fishing grounds, and c) the relative frequencies of the different year classes.

a) Rate of growth. Changes in the rate of growth affect in two ways the numbers of plaice of a given size available for capture. Firstly, as Johansen has shown, a comparatively great rate of growth in any year causes the stock of marketable plaice to be recruited in that year by comparatively many plaice, whilst a slight rate of growth on the other hand has the opposite effect [4]. Secondly a change in the average length makes other biological demands on an age group and thereby causes a change in the distribution.

In the North Sea the rate of growth has changed as follows: immediately after the end of the

[1] The unsorted plaice varying in quantity between 0.01 and 0.22 cwts do not appear in the table.

[2] W. Garstang, id. 1926. Compare also A. Bückmann: Prof. Garstangs Ansicht über die Überfischung des Schollenbestandes in der Nordsee. Der Fischerbote XVIII Jahrg. Hft. 12. 1926. and H. M. Kyle: Die Schollenfrage. Der Fischerbote XVIII Jahrg. Hft. 16. 1926.

[3] J. O. Borley and D. E. Thursby-Pelham, id. 1925. p. 15.

[4] A. C. Johansen: Bericht über die dänischen Untersuchungen über die Schollenfischerei und den Schollenbestand etc. Medd. f. Komm. f. Havunders. Ser. Fiskeri. Bd. III. No. 8. 1910.

war it was greatly checked both in the nursery grounds and in the open North Sea, but as the accumulated stock in the course of the years 1919 to 1922—1923 was depleted by fishing, the growth rate in the open North Sea must have increased. In the nursery grounds on the other hand, the growth rate decreased until 1922 as the numbers of plaice increased. The growth rate in the open North Sea presumably continued to increase until the year 1923, since, as may be seen from Table 44, the stock in the open North Sea was constantly reduced up to that date. After 1923 there has possibly been a decrease in the growth rate in the open North Sea (cp. p. 43).

The decreased growth rate in the open North Sea immediately after the war must have caused the category Small in that period to be recruited in one year by comparatively few plaice, and the augmented growth rate during the years 1919—1923 must have caused this same trade category to be recruited during this period by numbers of plaice increasing from year to year.

The decrease in average length of each age group was so considerable during the war that the average length of age group IV in 1919 was the same as that for age group III before the war, and the average length of an older age group was perhaps even less than that for the previous group before the war[1]. According to measurements taken in 1923 the trade category Small consisted of plaice between 20 and 39 cm. in length, their average length being about 28 cm. and their quartiles about 25 and about 34 cm.[2] Thus before the war it was principally the III-, IV-, and V-age groups that constituted the category Small, whilst after the war the age group III has been rather sparsely represented in it, whereas on the other hand several plaice of the VI-group must have been in this trade category. As the numbers of one year class are diminished from year to year, even apart from the loss caused by fishery, one would have expected in view of this change in the average length of each age group that there would be fewer plaice of the trade category Small immediately after the war than before it.

b) Situation of fishing grounds. The English trawl fishery was carried on during the years immediately after the war, when the accumulated stock furnished such a plentiful yield, almost exclusively in the open North Sea, but as the fishery gradually depleted this stock the trawlers extended their operations to the nursery grounds in the southern and south-eastern North Sea to an extent which increased from year to year[3]. These changes in the range of fishing operations must have tended to reduce the numbers of small plaice in the catches immediately after the war and to increase the numbers of this category in the catches during the subsequent period up to 1924. Possibly the intensive fishing on the nursery grounds in the German Bight during the last years of the war is one of the causes for the predominance of the large plaice over the small during the first years after the war[4].

c) The relative frequencies of the different year classes. The abundant year classes after 1919 must have contributed to the increase in numbers of the trade category Small from before the war (1913) to the years after 1923 in the catches of the English trawlers.

VIII. Resumé.

The material on which the foregoing investigation is based was collected at fishing experiments with a 50 ft. otter trawl at the beginning of April 1925, in October 1925 and at the end of March 1927 in the southern Horns Reef Area outside the 10 metre line.

[1] W. Wallace in J. O. Borley and Collaborators: The Plaice Fishery and the War. Ministry of Agriculture and Fisheries. Fishery Invest. Ser. II. Vol. 3. 1923.

[2] J. O. Borley and D. E. Thursby-Pelham, id. 1925, pp. 43—44.

[3] Compare J. O. Borley and D. E. Thursby-Pelham, id. 1925. Figs. 1—4.

[4] Herbert Heidrich: Der Schellfischbestand im Nordseegebiet nach Beendigung des Krieges 1914—1918. Ber. der Deutschen wiss. Komm. f. Meeresf. N. F. Bd. 1. 1923, p. 156.

The results of these fishing experiments as regards the size and age composition of the stock are shown in the charts Figs. 1—4, pp. 5—9, and 6—7, pp. 14—15, and in the Tables 1—4, pp. 5, 6, and 12—13, pp. 15, 16, a comparison being instituted between the results from these years and the results of fishing experiments carried out before the war and in September 1922.

The comparison shows that the numbers of the stock in the southern Horns Reef Area outside the 10 metre line was approximately the same in 1925 and 1927 as in 1922, but that during these years the proportion of larger and older plaice has increased.

Whereas in the autumn of 1922 it was the age group I and II (year classes 1920 and 1921) which were predominant in the area under discussion, the groups II—V predominated in the spring and autumn of 1925 as also in the spring of 1927. (Cp. Fig. 8, p. 21, and Fig. 9, p. 22). Both at the fishing experiments in 1925 and in 1927 the 1922 year class was numerically the largest. Since the numbers outside the 10 metre line were about the same during the three years, the total numbers in the southern Horns Reef Area from the coast outwards must have decreased during this period, as the abundance of the youngest age groups, whose main area of distribution lies between the coast and the 10 metre line, has constantly diminished.

The numbers of plaice exceeding 22.5 cm. in length in the southern Horns Reef Area outside the 10 metre line were about eight times as great in the autumn of 1925 as in the autumn of 1922, and double as great in the spring of 1927 as in the spring of 1925. The numbers of the larger plaice had increased still more, particularly from 1922 to 1925.

An investigation of the relative frequencies of the different year classes has shown that during the period 1919—1926 the 1922 year class was the most abundant but that the year 1925 also produced a considerable number of plaice. The 1919—1923 year classes were all abundant, the year 1921 having produced less plaice than 1923 or the same number. The year 1924, and also as far as can be estimated at the present time 1926, have produced the poorest year classes (cp. p. 27).

The changes in the rate of growth seem to have been caused by the decrease in total numbers, the average length of each age group having increased on the whole from 1922 to 1925 and again from 1925 to 1927 (cp. Fig. 10, p. 31). By comparing the changes in the numbers of any age group from 1925 to 1927 with the difference between its average lengths for the same two years, it has been shown that the average length of any year class is to a considerable extent determined by its abundance (cp. Fig. 11, p. 33). Moreover it has been shown that for each of the age groups I—V the average length at any station in the autumn varies in inverse proportion to the density at that station, when the number of the plaice of the age group in question caught at the fishing experiments is great enough for the mean length to be regarded as determined with sufficient accuracy (cp. Figs. 12 and 13, p. 38). This may be explained as a result of the competition between the plaice of each locality, and we may assume, in consideration of the amount of the variations in average length, that the stock found in any locality has consisted mainly of the same plaice throughout the summer.

An investigation of the relative frequencies of males and females has shown that, when the entire plaice stock of the area under discussion is taken as a whole, it cannot have undergone appreciable changes during these years. Diversities in the local distribution of the relative frequencies of males and females for the different years are difficult to explain.

An investigation of the centres of gravity or the mean depths of the different age groups in the area under discussion has shown that no greater changes have taken place than can be naturally explained by the variations in the different average lengths of the different age groups during these years.

A comparison has been instituted with the results of the investigations in the other areas of the nursery grounds in the southern and south-eastern North Sea. The Horns Reef Area shows a considerable similarity to the Heligoland region, whilst to the west other conditions seem to have prevailed, partly as regards the relation between the frequencies of the different year classes but particularly as regards the

growth of plaice, which does not seem to have been the same in the Leman-Haaks Area as in the eastern nursery grounds.

In the Horns Reef Area there does not seem to have been any banking up in the nursery grounds which can be ascribed to competition for food on the part of the accumulated stock in the open North Sea. It has therefore been investigated whether the changes in the distribution of the small plaice in the open North Sea which took place after the war can be explained otherwise than by the presumption that the small plaice were banked up after the war in an area along the continental coast. It has been pointed out that a) the connection existing, as proved by JOHANSEN, between the rate of growth and the yield of the fishery, b) the situation of the fishing grounds exploited by the trawl fishery, and c) the relative frequencies of the year classes, altogether seem to furnish an explanation for the changes which ensued during and after the war in the frequency of the trade category Small in the catches of the English steam trawlers.

Tables.

Results of analyses of age groups, sex, and length.

At four stations (3322, 3324, 3702, and 3704) only a representative part of the catches has been analysed for age groups. The numbers of plaice of the different age groups in the total catch will be found there as raised figures. At one station (3504), of the plaice under 20 cm. only a representative sample has been analysed. The numbers of these plaice in the different age groups will also be found as raised figures. At one station (3324) a small number of the I-group have not been analysed for length and are accordingly allotted figures proportional to those for the plaice already analysed.

Stat. 3319. — 2. April 1925. — 55° 16′ N. Lat. 8° 14′ E. Long. Depth: 13 m. — Duration of fishing: 1 hr.

Age group	I	II		III		IV		V		VI	?		Total
Sex	♂	♂	♀	♂	♀	♂	♀	♂	♀	♀	♂	♀	♂+♀
Length cm.													
9	..	3	1	..	..	..	..	..	..	..	..	..	4
10	..	6	6	4	2	..	..	..	..	..	..	..	18
11	..	9	7	15	5	..	..	..	..	..	1	..	37
12	..	8	10	35	19	..	1	..	..	..	..	1	74
13	..	7	10	32	38	..	..	..	..	..	..	..	87
14	..	3	5	29	42	..	..	..	..	..	..	..	79
15	..		4	17	11	1	..	..	..	..	1	2	36
16	..		3	11	23	1	3	..	..	..	1	..	42
17	..	..	..	10	13	2	1	..	2	..	1	..	29
18	..	..	..	6	8	1	2	..	1	..	..	..	18
19	1	..	..	3	7	3	4	..	..	1	..	1	20
20	..	..	1	3	5	2	10	..	..	..	1	..	22
21	..	..	..	1	3	2	5	2	5	..	..	..	18
22	..	1	..	..	..	..	4	1	1	..	..	..	7
23	..	..	..	1	..	..	1	..	1	..	..	..	3
24	..	..	..	..	..	..	3	..	1	..	..	..	4
Total	1	37	47	167	176	12	34	3	11	1	5	4	498
Average length ♂ and ♀	19.0	11.8	12.6	13.9	14.1	18.3	19.9	21.3	20.5	19.0	15.8	15.2	..
— — ♂+♀	19.0	12.2		14.0		19.4		20.7		19.0	15.6		

Stat. 3320. — 2. April 1925. — 55° 4′ N. Lat. 8° 16′ E. Long. Depth: 12 m. — Duration of fishing ½ hr.

Age group	II		III		IV		V		Total
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂+♀
Length cm.									
8	2	..	..	..	..	..	..	..	2
9	..	..	1	..	..	..	..	..	1
10	..	..	..	1	..	..	..	..	1
11	3	1	1	..	..	..	..	..	5
12	2	..	5	..	..	..	..	..	7
13	3	1	11	..	..	..	..	..	15
14	1	..	7	5	..	..	..	..	13
15	..	..	6	5	..	..	..	..	11
16	..	2	2	3	..	1	1	..	9
17	..	..	2	4	2	..	..	..	8
18	..	..	1	..	..	..	..	..	1
19	..	..	1	3	..	..	..	..	4
20	..	..	..	1	1	..	..	1	3
21	..	..	..	..	..	..	..	..	..
22	..	..	..	..	..	..	..	..	..
23	..	..	..	..	1	..	..	..	1
Total	11	4	37	22	4	1	1	1	81
Average length ♂ and ♀	11.5	14.0	13.9	15.8	19.2	16.0	16.0	20.0	..
— — ♂+♀	12.1		14.6		18.6		18.0		..

Stat. 3321. — 2. April 1925. — 55° 4′ N. Lat. 8° 00′ E. Long. Depth: 16 m. — Duration of fishing ½ hr.

Age group	II		III		IV		V		VI		Total
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂+♀
Length cm.											
11	.	1	..	1	..	..	..	..	..	..	2
12	2	1	3	..	..	..	..	..	..	..	6
13	3	1	4	1	..	..	..	..	..	.	9
14	4	..	3	2	..	..	..	..	..	..	9
15	..	1	8	2	..	..	..	..	..	..	11
16	..	.	5	3	..	2	..	..	.	..	10
17	..	..	2	3	..	..	1	..	..	..	6
18	..	..	1	3	..	..	..	1	..	..	5
19	..	..	..	1	1	1	..	2	1	..	6
20	..	..	..	2	2	..	..	..	..	..	4
21	..	..	..	..	2	4	1	1	1	1	10
22	..	..	..	..	1	2	..	..	2	..	5
23	..	..	..	..	..	..	1	1	..	..	2
24	..	..	..	..	1	..	..	..	..	..	1
25	..	..	..	..	..	1	1	2	3	..	7
26	..	..	..	..	..	..	..	..	1	1	2
27	..	..	..	..	..	..	..	2	..	1	3
28	..	..	..	..	..	..	..	..	..	..	..
29	..	..	..	..	..	..	..	..	..	..	..
30	..	..	..	..	..	..	..	1	..	..	1
Total	9	4	26	18	7	10	4	10	8	3	99
Average length ♂ and ♀	13.2	12.8	14.7	16.3	21.0	20.3	21.5	23.4	23.1	24.7	..
♂+♀	13.1		15.3		20.6		22.9		23.5		..

Stat. 3322. — 2. April 1925. — 55° 4′ N. Lat. 7° 45′ E. Long. Depth: 20 m. — Duration of fishing: 1 hr.

Age group	II		III		IV		V		VI		?	Total caught
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♂+♀
Length cm.												
13	..	..	..	..	..	..	..	..	..	..	..	12
14	..	..	..	..	..	..	..	..	..	..	..	30
15	1	..	3	1	..	..	..	..	..	..	..	54
16	2	2	6	3	..	..	..	..	..	..	..	115
17	..	..	7	5	..	..	..	..	..	..	..	166
18	..	..	10	7	1	..	..	..	..	..	..	158
19	..	..	10	9	1	1	..	..	..	..	..	146
20	..	..	4	2	6	2	1	..	..	..	..	149
21	1	..	3	2	2	2	3	2	..	..	..	134
22	..	..	..	..	6	2	4	3	1	..	1	195
23	..	..	..	..	3	2	2	1	2	..	..	95
24	..	..	..	..	1	2	1	3	..	..	..	96
25	..	..	..	..	2	2	1	2	1	..	..	83
26	..	..	..	1	2	1	5	1	..	..	..	58
27	..	..	..	..	..	1	..	2	..	..	..	26
28	..	..	..	..	..	..	1	1	1	..	..	23
29	..	..	..	..	..	1	1	1	..	4	..	13
30	..	..	..	..	..	..	1	2	..	..	..	5
31	..	..	..	..	..	..	..	..	1	2	..	8
32	..	..	..	..	..	..	..	..	..	1	..	3
33	..	..	..	..	..	..	..	..	..	..	..	1
34	..	..	..	..	..	..	..	..	..	1	..	2
Total determined for Age	4	2	43	30	24	16	20	18	6	8	1	172
Total caught	37	18	393	274	219	146	183	165	55	73	9	1572
Average length ♂ and ♀	17.0	16.0	18.0	18.4	21.9	23.2	24.2	25.0	25.3	30.5	20.0	..
— — ♂+♀	16.7		18.2		22.4		24.6		28.3		20.0	

Stat. 3323. — 3. April 1925. — 55° 16′ N. Lat. 7° 58′ E. Long. Depth: 18 m. — Duration of fishing: 1/2 hr.

Age group	I	II		III		IV		V		VI		Total caught
Sex	♂+♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂+♀
Length cm.												
6	1	..	..	..	..	..	..	..	..	..	..	4
7	3	..	..	..	..	..	..	..	..	..	..	7
8	1	1	..	..	..	..	..	..	..	..	..	8
9	2	2	..	..	..	..	..	..	..	..	..	7
10	1	4	..	..	..	..	..	..	..	..	..	17
11	..	3	5	3	..	..	..	..	..	..	..	22
12	1	7	4	4	2	..	..	..	..	..	..	35
13	..	1	2	5	2	..	..	..	..	..	..	40
14	..	2	..	13	2	..	..	..	..	..	..	75
15	..	2	..	3	3	..	..	..	..	..	..	52
16	..	..	1	4	2	..	1	..	..	..	..	38
17	..	1	2	5	3	1	..	..	..	..	..	47
18	..	..	..	..	2	3	3	..	..	..	..	28
19	..	..	..	3	5	..	2	..	2	..	..	40
20	..	..	..	2	3	5	6	2	2	..	..	58
21	..	..	..	2	1	2	4	3	4	1	..	54
22	..	..	..	2	..	5	6	7	3	..	1	64
23	..	..	..	..	2	1	1	3	7	..	..	54
24	..	..	..	1	..	2	2	5	3	..	..	51
25	..	..	..	..	..	..	3	3	2	..	..	19
26	..	..	..	..	..	..	..	2	..	1	..	10
27	..	..	..	..	..	..	..	..	..	..	..	7
28	..	..	..	..	..	..	..	..	1	..	..	3
29	..	..	..	..	..	..	..	..	..	..	..	2
Total determined for Age	9	23	14	47	27	19	28	25	24	2	1	219
Total caught	30	78	47	159	91	64	95	85	81	7	3	742
Average length ♂ and ♀	..	11.7	12.8	15.5	17.2	20.7	21.1	22.7	22.2	23.5	22.0	..
— — ♂+♀	8.3	12.2		16.2		20.9		22.4		23.0		

Stat. 3324. — 3. April 1925. — 55° 16′ N. Lat. 7° 41′ E. Long. Depth: 25 m. — Duration of fishing: 1 hr.

1 Specimen. Age group: I. Sex: ♂. Length: 6 cm.

Stat. 3327. — 4. April 1925. — 55° 29,5′ N. Lat. 8° 3′ E. Long. Depth: 25 m. — Duration of fishing: ½ hr.

Age group	I	II		III		IV		V		Total
Sex	♂	♂	♀	♂	♀	♂	♀	♂	♀	♂+♀
Length cm.										
4	1	..	..	..	..	..	..	..	..	1
5	..	..	..	..	..	..	..	..	..	..
6	..	..	..	..	..	..	..	..	..	..
7	1	..	..	..	..	..	..	..	..	1
8	..	..	..	..	..	..	..	..	..	..
9	..	..	1	..	..	..	..	..	..	1
10	..	..	..	..	..	..	..	..	..	..
11	..	..	1	..	1	..	..	..	..	2
12	..	..	..	1	..	..	..	..	..	1
13	..	..	2	1	1	..	..	..	..	4
14	..	2	2	..	3	..	..	..	..	7
15	..	..	..	1	1	..	..	..	..	2
16	..	1	2	2	..	..	..	..	..	5
17	..	..	..	2	3	..	..	1	..	6
18	..	..	..	3	3	..	1	1	..	8
19	..	..	..	2	..	..	1	..	..	3
20	..	..	..	2	1	1	1	..	..	5
21	..	..	..	2	1	3	..	..	..	6
22	..	..	..	..	..	1	..	..	..	1
23	..	..	..	..	..	2	1	..	..	3
24	..	..	..	..	..	..	..	..	..	..
25	..	..	..	..	..	1	..	..	..	1
26	..	..	..	..	..	..	..	1	..	1
27	..	..	..	..	..	..	..	..	..	..
28	..	..	..	..	..	..	..	..	1	1
Total	2	3	8	16	14	8	4	3	1	59
Average length ♂ and ♀	5.5	14.7	13.2	17.5	16.2	22.0	20.0	20.3	28.0	
— — ♂+♀	5.5	13.8		16.9		21.3		22.2		

Stat. 3328. — 4. April 1925. — 55° 27,5′ N. Lat. 8° 11′ E. Long. Depth: 10 m. — Duration of fishing: ½ hr.

Age group	I	II		III		IV		V		VI		?	Total[1])
Sex	♂+♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♂+♀
Length cm.													
6	3	..	..	..	..	..	..	..	..	..	..	..	3 (+ 1)
7	7	..	..	..	..	..	..	..	..	..	..	..	7 (+ 3)
8	8	..	..	1	..	..	..	..	..	..	..	..	9 (+ 4)
9	6	1	2	..	..	..	..	..	..	..	..	..	9 (+ 3)
10	3	6	4	1	..	..	..	..	..	..	..	..	14 (+ 1)
11	1	5	6	..	1	1	1	..	..	..	..	..	15
12	..	7	6	12	9	1	..	..	..	..	..	..	35
13	..	6	14	7	6	..	..	..	..	..	..	..	33
14	..	7	10	10	15	..	..	..	..	..	..	1	43
15	..	6	11	13	10	..	..	..	..	..	..	..	40
16	..	2	3	13	22	1	2	..	..	..	..	..	43
17	..	..	1	8	12	1	..	..	..	..	..	1	23
18	..	..	1	11	15	3	..	1	1	..	..	..	32
19	..	..	..	8	6	2	2	..	1	..	..	..	19
20	..	1	..	4	8	6	6	1	1	..	..	..	27
21	..	..	..	1	6	2	6	..	2	..	..	..	17
22	..	..	..	1	1	2	8	1	1	..	..	..	14
23	..	..	..	..	..	4	3	2	3	..	..	..	12
24	..	..	..	..	1	1	1	1	..	1	1	..	6
25	..	..	..	..	..	..	..	..	..	..	..	..	..
26	..	..	..	..	1	..	1	1	1	..	..	..	4
27	..	..	..	..	..	..	..	1	..	..	..	..	1
28	..	..	..	..	..	..	..	..	1	..	..	..	1
Total determined for Age	28	41	58	90	113	24	30	8	11	1	1	2	407
Total caught	40	41	58	90	113	24	30	8	11	1	1	2	419
Average length ♂ and ♀	..	12.8	13.2	15.6	16.4	19.6	20.7	23.0	22.1	24.0	24.0	15.5	
— — ♂+♀	8.1	13.0		16.0		20.2		22.5		24.0		15.5	

[1]) The figures in brackets gives the numbers of plaice (of the I-Gr.) not measured.

Stat. 3499. — 14. Oct. 1925. — 55° 26′ N. Lat. 7° 55′ E. Long. Depth: 12 m. — Duration of fishing: 1 hr.

Age group	0	I		II		III		IV		V		VI	Total
Sex	♂+♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♀	♂ + ♀
Length cm.													
5	2	..	..	..	..	..	..	..	..	..	..		2
6	20	..	..	..	..	..	..	..	..	..	..		20
7	76	..	..	..	..	..	..	..	..	..	..		76
8	27	..	..	..	..	..	..	..	..	..	..		27
9	3	1	..	..	..	..	..	..	..	..	..		4
10	1	..	..	..	..	..	..	..	..	..	..		1
11	..	4	..	..	..	..	..	..	..	..	..		4
12	..	9	17	1	..	..	..	..	..	..	..		27
13	..	23	18	..	1	..	..	..	..	..	..	..	42
14	..	9	7	3	1	..	..	..	..	..	..	..	20
15	..	12	7	6	4	1	1	..	..	..	..	..	31
16	..	1	1	12	7	1	3	..	..	..	..	..	25
17	..	..	1	10	7	5	2	..	..	..	..	..	25
18	..	3	..	14	7	6	3	..	..	..	..	..	33
19	..	..	..	5	3	11	8	..	..	..	..	..	27
20	..	..	..	1	3	10	8	1	2	..	..	..	25
21	..	..	..	2	3	5	3	..	..	..	..	..	13
22	..	..	..	..	..	4	8	2	..	..	..	..	14
23	..	..	..	..	2	4	3	..	..	..	..	1	10
24	..	..	..	..	..	5	1	..	1	1	1	..	9
25	..	..	..	..	..	..	..	..	1	..	2	..	3
26	..	..	..	..	..	1	..	..	1	1	1	..	4
27	..	..	..	..	..	..	1	1	..	..	1	..	3
28	..	..	..	..	..	..	..	..	..	..	..	..	1
29	..	..	..	..	..	..	1	..	..	..	..	..	1
Total	129	62	51	54	38	53	42	4	5	2	6	1	447
Average lenght ♂ and ♀	..	13.5	13.2	16.9	17.6	20.1	20.3	22.8	23.0	25.0	25.8	23.0	
— — ♂+♀	7.1	13.4		17.2		20.2		22.9		25.6		23.0	

Stat. 3501. — 15. Oct. 1925. — 55° 20′ N. Lat. 8° 16′ E. Long. Depth: 15 m. — Duration of fishing: ½ hr.

Age group	0	I		II		III		V	Total
Sex	♂+♀	♂	♀	♂	♀	♂	♀	♂	♂+♀
Length cm.									
6	5	..	..	..	..	..	..	..	5
7	8	..	..	..	..	..	..	..	8
8	1	..	..	..	..	..	..	..	1
9	..	..	..	..	..	..	..	..	
10	..	..	..	..	..	..	..	..	..
11	..	3	..	..	..	..	..	..	3
12	..	3	2	..	..	..	..	..	5
13	..	..	1	..	..	..	..	..	1
14	..	1	1	..	..	..	..	..	2
15	..	2	..	..	1	2	..	..	5
16	..	..	3	..	6	1	1	..	11
17	..	..	..	..	2	1	1	..	4
18	..	..	..	..	1	..	..	..	1
19	..	..	..	2	..	1	2	..	5
20	..	..	..	1	..	1	1	..	3
21	..	..	..	..	..	1	1	..	2
22	..	..	..	1	1	..	..	1	3
23	..	..	..	..	..	..	..	..	..
24	..	..	..	..	..	..	..	1	1
25	..	..	..	..	..	1	..	..	1
Total	14	9	7	4	11	8	6	2	61
Average length ♂ and ♀	..	12.6	14.1	20.0	16.9	18.5	18.7	23.0	
— — ♂+♀	6.7	13.3		17.7		18.6		23.0	

Stat. 3502. — 15. Oct. 1925. — 55° 20′ N. Lat. 8° 1′ E. Long.
Depth: 18 m. — Duration of fishing: 1/2 hr.

Age group	0	I		II		III		IV	V	Total
Sex	♂+♀	♂	♀	♂	♀	♂	♀	♀	♀	♂+♀
Length cm.										
6	10	..	..	..	..	..	..	..	..	10
7	11	..	..	..	..	..	..	..	..	11
8	7	..	..	..	..	..	..	..	..	7
9	..	..	..	..	..	..	..	..	..	..
10	..	1	..	..	..	..	..	..	..	1
11	..	4	..	..	..	..	..	..	..	4
12	..	4	1	..	..	..	..	..	..	5
13	..	7	3	1	..	1	..	..	..	12
14	..	6	3	1	..	1	..	..	..	11
15	..	2	2	6	1	..	1	..	..	12
16	..	2	1	6	6	4	1	..	..	20
17	..	..	..	6	2	2	5	..	..	15
18	..	1	..	..	2	6	4	..	..	13
19	..	..	..	2	2	3	4	..	..	11
20	..	..	..	1	1	3	6	1	..	12
21	..	..	..	..	1	..	..	..	..	1
22	..	..	..	..	..	..	..	..	1	2
23	..	..	..	1	..	..	..	..	..	1
24	..	..	..	..	..	2	..	..	1	3
25	..	..	..	..	..	..	..	..	..	..
26	..	..	..	..	..	..	..	..	..	..
27	..	..	..	..	..	..	1	..	1	2
28	..	..	..	..	..	..	..	..	..	..
29	..	..	..	..	..	..	1	..	..	1
Total	28	27	10	24	16	22	23	1	3	154
Average length ♂ and ♀	..	13.2	13.9	16.5	17.7	18.1	19.2	20.0	24.3	..
— — ♂+♀	6.9	13.4		17.0		18.6		20.0	24.3	..

Stat. 3503. — 15. Oct. 1925. — 55° 20′ N. Lat. 7° 45′ E. Long.
Depth: 23 m. — Duration of fishing: 1/2 hr.

Age group	0	I		II		III		IV	V	VI	Total
Sex	♂+♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♂+♀
Length cm.											
7	4	..	..	..	..	..	..	..	..	..	4
8	8	..	..	..	..	..	..	..	..	..	8
9	1	..	..	..	..	..	..	..	..	..	1
10	..	..	1	..	..	..	..	..	..	..	1
11	..	9	1	..	..	..	..	..	..	..	10
12	..	4	4	..	..	..	..	..	..	..	8
13	..	4	3	..	..	..	..	..	..	..	7
14	..	5	3	2	..	..	..	..	..	..	10
15	..	3	..	4	2	1	..	..	..	..	10
16	..	3	1	4	4	1	1	..	..	..	14
17	..	..	..	1	1	2	8	..	..	..	12
18	..	..	..	1	3	..	1	..	..	..	5
19	..	..	..	..	1	3	3	..	..	..	7
20	..	..	..	4	..	2	..	..	..	..	6
21	..	..	..	1	2	..	1	..	..	..	4
22	..	..	..	..	..	..	3	..	..	..	3
23	..	..	..	..	..	1	..	..	..	..	1
24	..	..	..	..	..	..	..	1	1	..	2
25	..	..	..	..	..	..	..	1	..	..	1
26	..	..	..	..	..	..	..	..	..	..	..
27	..	..	..	..	..	..	..	..	1	1	2
28	..	..	..	..	..	..	..	..	..	..	..
29	..	..	..	..	..	..	..	..	..	..	..
30	..	..	..	..	..	..	..	..	..	..	..
31	..	..	..	..	..	..	..	..	2	1	3
Total	13	28	13	17	13	10	17	2	4	2	119
Average length ♂ and ♀	..	12.9	12.8	16.9	17.4	18.5	18.5	24.5	28.2	29.0	..
— — ♂+♀	7.8	12.9		17.1		18.5		24.5	28.2	29.0	..

Stat. 3504[1]). — 15. Oct. 1925. — 55° 20′ N. Lat. 7° 20′ E. Long. Depth: 26 m. — Duration of fishing: 1 hr.

Age group	I		II		III		IV		V		VI		VII	Total
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♀	♂+♀
Length cm.														
12	4	5	..	..	..	..	..	..	..	..	..	..	..	9
13	5	..	11	17	..	..	..	..	..	..	..	..	..	33
14	9	5	52	34	9	10	..	..	..	..	..	..	..	119
15	4	..	105	92	18	27	..	..	..	..	..	..	..	246
16	3	..	94	68	60	88	..	..	..	..	..	..	..	313
17	..	..	51	79	61	97	..	..	..	..	..	..	..	288
18	..	..	33	26	30	76	..	..	..	..	..	..	..	165
19	..	..	6	15	35	54	6	..	..	..	..	..	..	116
20	..	..	5	9	18	34	5	5	..	..	..	..	..	76
21	..	..	4	3	17	16	2	4	1	1	..	..	..	48
22	..	..	1	2	13	15	3	5	1	4	..	..	..	44
23	..	..	2	3	6	8	4	9	3	4	..	..	..	39
24	..	..	..	..	4	8	6	3	2	3	1	..	..	27
25	..	..	..	1	2	5	5	6	6	11	..	..	1	37
26	..	..	..	..	1	1	1	5	4	5	..	..	..	17
27	..	..	..	..	..	1	1	3	3	2	..	..	..	10
28	..	..	..	..	..	..	1	..	..	3	..	1	..	5
29	..	..	..	..	1	..	..	..	1	4	..	..	..	6
30	..	..	..	..	..	1	..	..	..	..	..	..	..	1
31	..	..	..	..	..	..	..	..	..	1	..	..	..	1
Total	25	10	364	349	275	441	34	40	21	38	1	1	1	1599
Average length ♂ and ♀	13.9	13.0	15.9	16.2	18.0	18.0	22.5	23.4	25.0	25.3	24.0	28.0	25.0	
— — ♂+♀	13.7		16.0		18.0		22.9		25.2		26.0		25.0	

[1]) The numbers of plaice of the different age-groups for the lengths 12—20 cms are raised figures, because 981 plaice of these sizes are only analysed for sex and length.

Stat. 3505. — 16. Oct. 1925. — 55° 27′ N. Lat. 7° 37′ E. Long. Depth: 26 m. — Duration of fishing $^1/_2$ hr.

Age group	0	I		II		III		IV		V		VI		Total
Sex	♂+♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂+♀
Length cm.														
8	18	..	..	..	..	..	..	..	..	..	..	..	..	18
9	10	..	..	..	..	..	..	..	..	..	..	..	..	10
10	1	1	..	..	..	..	..	..	..	..	..	..	..	2
11	..	3	..	..	..	..	..	..	..	..	..	..	..	3
12	..	5	2	..	..	..	..	..	..	..	..	..	..	7
13	..	6	3	..	..	..	..	..	..	..	..	..	..	9
14	..	1	1	..	..	..	..	..	..	..	..	..	..	2
15	..	4	..	5	1	1	..	..	..	..	..	..	..	11
16	..	1	..	4	3	1	1	..	..	..	..	..	..	11
17	..	..	1	7	2	1	2	..	..	..	..	..	..	13
18	..	..	..	3	6	1	3	..	..	..	..	..	..	13
19	..	..	..	3	1	2	..	..	..	..	..	..	..	6
20	..	..	..	..	..	2	2	..	..	..	..	..	..	4
21	..	..	..	3	..	2	6	..	..	1	..	..	..	12
22	..	..	..	..	1	2	2	1	2	..	1	..	..	9
23	..	..	..	..	..	2	3	..	1	1	..	..	..	7
24	..	..	..	..	..	1	3	2	3	2	..	..	..	11
25	..	..	..	..	..	1	2	1	..	..	3	..	..	7
26	..	..	..	..	..	2	..	1	..	1	2	..	..	6
27	..	..	..	..	..	..	..	..	1	..	1	..	..	2
28	..	..	..	..	..	..	..	..	1	1	1	..	1	4
29	..	..	..	..	..	..	1	..	1	3	3	1	..	9
30	..	..	..	..	..	..	..	..	..	2	..	..	..	2
31	..	..	..	..	..	..	..	..	..	..	..	..	1	1
32	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Total	29	21	7	25	14	18	25	5	9	11	11	1	3	179
Average length ♂ and ♀	..	12.9	13.4	17.3	17.6	20.9	21.4	24.2	24.8	26.6	26.5	29.0	30.3	
— — ♂+♀	8.4	13.0		17.4		21.2		24.6		26.6		30.0		

Stat. 3507. — 16. Oct. 1925. — 55° 27′ N. Lat. 6° 53′ E. Long. Depth: 30 m. — Duration of fishing: 1 hr.

Age group	I	II		III		IV		V		Total
Sex	♂	♂	♀	♂	♀	♂	♀	♂	♀	♂+♀
Length cm.										
15	..	..	1	..	..	..	..	..	..	1
16	..	4	..	3	1	..	..	..	..	8
17	1	9	5	9	5	..	..	..	..	29
18	..	4	5	17	11	..	..	..	..	37
19	..	5	4	11	10	..	..	..	..	30
20	..	1	..	8	5	..	1	..	..	15
21	..	1	..	6	6	..	..	1	..	14
22	..	..	2	4	6	3	2	1	..	18
23	..	..	1	1	3	5	1	..	..	11
24	..	..	..	5	2	4	2	..	1	14
25	..	..	..	1	2	..	..	2	2	17
26	..	..	..	1	1	1	3	3	3	12
27	..	..	..	..	1	1	1	4	1	8
28	..	..	..	..	..	2	..	2	1	5
29	..	..	..	..	1	..	..	..	..	1
30	..	..	..	..	..	..	..	..	..	1
31	..	..	..	..	..	..	..	..	1	1
32	..	..	..	..	..	..	..	..	1	1
Total	1	24	18	66	54	17	10	13	10	213
Average length ♂ and ♀	17.0	17.7	18.5	19.5	20.3	24.5	24.0	25.8	27.0	
— — ♂+♀	17.0	18.0		19.8		24.3		26.3		

Stat. 3508. — 16. Oct. 1925. — 55°27′ N. Lat. 7°15′ E. Long. Depth: 25 m. — Duration of fishing: $^1/_2$ hr.

Age group	I	II		III		IV		V		VI		Total
Sex	♂	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂+♀
Length cm.												
14	1	3	2	..	1	..	..	..	..	..	..	7
15	..	16	3	4	1	..	..	..	..	..	..	24
16	2	29	9	9	4	..	..	..	..	..	..	53
17	..	21	7	24	11	..	..	..	..	..	..	63
18	..	16	1	16	7	1	..	..	..	..	..	41
19	..	3	2	20	16	..	..	..	..	..	..	41
20	..	3	..	20	14	1	..	..	..	..	..	38
21	..	2	2	13	6	2	1	..	1	..	1	28
22	..	1	..	11	4	3	3	2	..	..	..	24
23	..	1	..	6	8	1	1	1	..	1	..	19
24	..	..	..	6	4	1	3	1	1	..	..	16
25	..	..	..	1	2	2	1	..	7	1	..	14
26	..	..	..	2	..	2	5	..	..	..	..	9
27	..	..	..	..	..	2	3	1	1	..	..	7
28	..	..	..	..	..	..	..	..	..	..	..	..
29	..	..	..	2	..	..	..	1	1	..	..	4
Total	3	95	26	134	78	15	17	6	11	2	1	388
Average length ♂ and ♀	15.3	16.8	16.7	19.5	19.7	23.3	24.6	24.5	25.1	24.0	21.0	
— — ♂+♀	15.3	16.8		19.6		24.0		24.9		23.0		

Stat. 3509. — 17. Oct. 1925. — 55°28′ N. Lat. 8°11′ E. Long. Depth: 9 m. — Duration of fishing: $^1/_2$ hr.

Age group	0	I		II		III		IV	Total
Sex	♂+♀	♂	♀	♂	♀	♂	♀	♀	♂+♀
Lenght cm.									
5	69	..	..	..	..	..	..	..	69
6	177	..	..	..	..	..	..	..	177
7	118	..	..	..	..	..	..	..	118
8	24	..	..	..	..	..	..	..	24
9	5	..	..	..	..	..	..	..	5
10	..	1	1	..	..	..	..	..	2
11	..	2	..	..	..	..	..	..	2
12	..	3	3	..	..	..	..	..	6
13	1	7	5	1	1	..	1	..	16
14	..	2	2	1	1	..	..	..	6
15	..	3	4	1	..	..	..	..	8
16	..	5	1	4	2	2	..	..	14
17	..	..	1	3	3	1	1	..	9
18	..	..	..	3	2	1	1	..	7
19	..	..	..	..	..	1	4	..	5
20	..	..	..	1	..	3	1	..	5
21	..	..	..	..	2	2	1	..	5
22	..	..	..	..	1	1	1	..	3
23	..	..	..	1	..	..	2	..	3
24	..	..	..	..	..	..	..	..	..
25	..	..	..	..	..	..	..	..	..
26	..	..	..	..	..	..	..	..	..
27	..	..	..	..	..	..	..	1	1
Total	394	23	17	15	12	11	12	1	485
Average length ♂ and ♀	..	13.6	13.6	16.9	17.5	19.1	19.4	27.0	
— — ♂+♀	6.3	13.6		17.2		19.3		27.0	

Stat. 3511. — 19. Oct. 1925. — 55°10′ N. Lat. 8°13′ E. Long. Depth: 12 m. — Duration of fishing: $^1/_2$ hr.

Age group	0	I		II		III		IV		V		Total
Sex	♂+♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂+♀
Length cm.												
6	5	..	..	..	..	..	..	..	..	..	..	5
7	1	..	..	..	..	..	..	..	..	..	..	1
8	..	..	..	..	..	..	..	..	..	..	..	..
9	..	1	1	..	..	..	..	..	..	..	..	2
10	..	2	..	..	..	..	..	..	..	..	..	2
11	..	..	1	..	..	..	..	..	..	..	..	1
12	..	1	..	..	..	..	..	..	..	..	..	1
13	..	1	1	..	1	..	..	..	..	..	..	3
14	..	..	..	5	1	1	1	..	..	..	..	8
15	..	2	..	3	1	1	..	..	..	..	..	7
16	..	..	1	6	3	4	5	..	..	..	..	19
17	..	..	..	2	2	8	7	..	..	..	..	19
18	..	..	..	2	3	6	4	..	..	..	..	15
19	..	..	..	1	1	3	4	1	..	..	..	10
20	..	..	..	..	2	4	5	..	2	..	..	13
21	..	..	..	1	1	3	1	..	..	..	..	6
22	..	..	..	..	1	1	1	..	1	..	..	4
23	..	..	..	..	..	..	1	..	..	1	1	3
24	..	..	..	..	..	..	..	..	2	..	..	2
25	..	..	..	..	..	..	..	..	..	..	..	.
26	..	..	..	..	..	..	..	..	..	1	..	1
27	..	..	..	..	..	..	..	..	1	..	..	1
28	..	..	..	..	..	..	..	..	..	..	..	..
29	..	..	..	..	..	..	..	..	..	..	..	..
30	..	..	..	..	..	..	..	..	..	..	1	1
Total	6	7	4	20	16	31	29	1	6	2	2	124
Average length ♂ and ♀	..	12.0	12.2	16.0	17.5	18.0	18.2	19.0	22.8	24.5	26.5	
— — ♂+♀	6.2	12.1		16.7		18.1		22.3		25.5		

Stat. 3512. — 19. Oct. 1925. — 55° 10′ N. Lat. 7° 55′ E. Long. Depth: 19 m. — Duration of fishing: ½ hr.

Age group	0	I		II		III		IV		V		VI	Total
Sex	♂+♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♂+♀
Length cm.													
5	1	..	..	..	..	..	..	..	..	..	..	..	1
6	22	..	..	..	..	..	..	..	..	..	..	..	22
7	59	..	..	..	..	..	..	..	..	..	..	..	59
8	8	..	..	..	..	..	..	..	..	..	..	..	8
9	1	..	..	..	..	..	..	..	..	..	..	..	1
10	..	4	..	..	..	..	..	..	..	..	..	..	4
11	..	10	2	..	..	..	..	..	..	..	..	..	12
12	..	7	5	..	1	..	..	..	..	..	..	..	13
13	..	8	2	2	4	..	..	..	..	..	..	..	16
14	..	2	..	3	7	1	..	..	..	..	..	..	13
15	..	..	..	16	10	2	2	..	..	..	..	..	30
16	..	..	..	13	11	5	2	..	..	..	..	..	31
17	..	..	..	5	8	7	9	1	..	..	..	..	30
18	..	..	..	5	4	14	13	..	..	..	..	..	36
19	..	..	..	1	3	7	11	..	..	..	..	..	22
20	..	..	..	2	..	9	11	1	1	..	..	..	24
21	..	..	..	..	..	5	5	2	..	..	..	..	12
22	..	..	..	..	..	1	4	2	1	..	..	..	8
23	..	..	..	..	..	3	1	3	..	..	..	..	7
24	..	..	..	..	..	1	..	2	..	..	..	1	4
25	..	..	..	..	..	1	..	2	1	2	1	..	7
26	..	..	..	..	..	..	..	..	2	1	1	..	4
27	..	..	..	..	..	..	..	1	..	..	..	..	1
28	..	..	..	..	..	..	..	..	..	..	1	..	1
29	..	..	..	..	..	..	..	..	..	1	2	..	3
30	..	..	..	..	..	..	..	..	..	..	1	..	1
Total	91	31	9	47	48	56	58	14	5	4	6	1	370
Average length ♂ and ♀	..	11.8	12.0	16.0	15.7	18.8	18.9	22.6	23.8	26.2	27.8	24.0	..
— — ♂+♀	6.8	11.8		15.8		18.8		22.9		26.7		24.0	..

Stat. 3513. — 19. Oct. 1925. — 55° 10′ N. Lat. 7° 35′ E. Long. Depth: 23 m. — Duration of fishing: ½ hr.

Age group	II		III		IV		V		VI		Total
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂+♀
Length cm.											
15	2	2	..	..	..	..	..	..	..	..	4
16	4	4	3	1	..	..	..	..	..	..	12
17	4	..	5	1	1	..	..	..	..	..	11
18	3	1	10	5	..	..	..	..	..	..	19
19	6	..	9	14	..	..	..	..	..	..	29
20	2	1	10	10	1	..	..	..	..	..	24
21	2	1	16	13	2	..	..	2	..	..	36
22	1	1	6	10	3	2	..	1	..	..	24
23	..	..	4	7	1	1	..	4	..	..	17
24	..	..	5	3	6	5	..	4	..	..	23
25	..	..	3	5	4	6	2	5	..	..	25
26	..	..	..	..	6	7	3	6	..	..	22
27	..	1	1	1	4	9	5	10	1	1	33
28	..	..	..	1	1	2	5	10	1	..	20
29	..	..	..	..	..	1	3	5	1	..	10
30	..	..	..	..	..	2	..	3	1	1	7
31	..	..	..	..	..	..	..	..	..	1	1
32	..	..	..	..	..	..	..	..	..	..	..
33	..	..	..	..	..	..	..	2	..	..	2
34	..	..	..	..	..	..	..	1	..	..	1
Total	24	11	72	71	29	35	18	53	4	3	320
Average length ♂ and ♀	18.1	18.4	20.4	21.1	24.3	25.9	27.2	26.8	28.5	29.3	..
— — ♂+♀	18.2		20.7		25.2		26.9		28.9		..

Stat. 3514. — 19. Oct. 1925. — 55°10′ N. Lat. 7°14′ E. Long. Depth: 32 m. — Duration of fishing: ½ hr.

Age group	II	III		IV		V		VI		Total
Sex	♂	♂	♀	♂	♀	♂	♀	♂	♀	♂+♀
Length cm.										
16	..	..	1	..	..	..	..	..	..	1
17	1	..	..	..	..	..	..	..	..	1
18	..	1	..	..	..	..	..	..	..	1
19	..	4	2	..	..	..	..	..	..	6
20	..	4	1	1	..	..	..	..	..	6
21	..	6	2	..	..	..	..	..	..	8
22	..	1	1	..	..	..	..	..	..	2
23	..	2	3	..	1	1	..	..	..	7
24	..	2	1	2	..	..	..	..	..	5
25	..	..	..	4	4	2	1	..	..	11
26	..	..	..	1	3	3	1	..	..	8
27	..	..	1	2	4	1	3	..	..	11
28	..	..	..	1	1	..	1	..	..	3
29	..	..	..	..	1	..	..	..	1	2
30	..	..	..	..	..	..	..	..	..	..
31	..	..	1	..	..	..	1	1	..	3
32	..	..	..	..	..	1	..	..	..	1
33	..	..	..	..	..	..	..	..	..	..
34	..	..	..	..	..	..	1	..	..	1
Total	1	20	13	11	14	8	8	1	1	77
Average length ♂ and ♀	17.0	20.8	22.2	25.1	26.1	26.2	28.1	31.0	29.0	
— — ♂+♀	17.0	21.4		25.7		27.2		30.0		

Stat. 3515. — 19. Oct. 1925. — 55°10′ N. Lat. 6°53′ E. Long. Depth: 34 m. — Duration of fishing: 1 hr.

Age group	II		III		IV		V		VI		VII		Total
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂+♀
Length cm.													
17	..	..	..	2	..	..	..	..	..	..	..	..	2
18	5	..	3	3	..	..	..	..	..	..	..	..	11
19	2	..	9	8	..	..	..	..	..	..	..	..	19
20	3	1	46	15	3	2	1	..	..	..	..	..	71
21	2	..	35	21	4	1	1	1	..	..	..	..	65
22	..	..	26	14	1	6	1	1	..	..	..	..	49
23	..	1	8	12	15	8	3	3	..	..	..	..	50
24	1	2	6	5	14	9	9	3	..	..	1	1	51
25	..	..	8	2	15	4	8	6	..	..	..	1	44
26	..	..	2	1	5	6	8	6	1	..	1	1	31
27	..	..	2	1	2	3	5	4	..	..	..	..	17
28	..	..	..	1	1	1	1	2	..	..	..	..	6
29	..	..	1	..	..	..	..	6	..	1	1	..	9
30	..	..	..	..	..	..	1	1	2	..	..	..	4
31	..	..	..	..	..	..	..	..	..	1	..	..	1
Total	13	4	146	85	60	40	38	33	3	2	3	3	430
Average length ♂ and ♀	19.5	22.8	21.3	21.4	23.9	24.0	25.0	26.0	28.7	30.0	26.3	25.0	
— — ♂+♀	20.3		21.3		23.9		25.5		29.2		25.7		

Stat. 3516. — 20. Oct. 1925. — 55°10′ N. Lat. 6°7′ E. Long. — Depth: 47 m. Duration of fishing: 1 hr.

Age group	III		IV		V		VI		Total
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂+♀
Length cm.									
21	1	..	..	..	..	..	..	..	1
22	1	1	1	..	..	..	..	..	3
23	1	..	1	..	..	..	..	..	2
24	..	1	1	..	..	..	..	..	2
25	1	2	1	2	..	..	..	..	6
26	..	..	2	1	4	1	..	..	8
27	1	1	..	5	2	4	..	..	13
28	1	..	..	..	3	1	..	1	6
29	..	..	..	..	2	4	..	..	8
30	..	..	1	1	..	3	..	..	4
31	..	..	1	..	1	..	1	..	2
Total	6	5	8	9	12	13	1	1	55
Average length ♂ and ♀	24.3	24.6	25.6	26.7	27.6	28.3	31.0	28.0	
♂+♀	24.5		26.2		28.0		29.5		

Stat. 3517. — 20. Oct. 1925. — 55°20′ N. Lat. 6°7′ E. Long. — Depth: 50 m. Duration of fishing: 1 hr.

Age group	II	III		IV		V		VI	Total
Sex	♂	♂	♀	♂	♀	♂	♀	♂	♂+♀
Length cm.									
20	..	1	..	..	..	..	..	..	1
21	..	..	..	..	..	..	..	..	..
22	1	..	..	..	..	..	..	..	1
23	..	..	..	..	..	..	..	..	..
24	..	..	..	1	..	..	..	..	1
25	..	1	..	1	..	..	..	..	2
26	..	2	1	..	1	..	..	..	4
27	..	..	..	1	1	2	1	..	5
28	..	..	..	..	2	..	1	..	3
29	..	..	..	..	1	1	1	1	4
30	..	..	..	..	..	1	1	..	2
31	..	..	..	..	..	1	..	1	2
32	..	..	..	..	..	..	1	..	1
Total	1	4	1	3	5	5	5	2	26
Average length ♂ and ♀	22.0	24.2	26.0	25.3	27.8	28.8	29.2	30.0	
♂+♀	22.0	24.6		26.8		29.0		30.0	

Stat. 3518. — 20. Oct. 1925. — 55°27′ N. Lat. 6°7′ E. Long. — Depth: 49 m. — Duration of fishing: 1 hr.

Age group	II		III		IV		V		VI	Total	
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♀	♂	♀
Length cm.											
20	..	..	1	..	..	..	..	..	..	1	
21	..	..	1	..	..	..	..	..	..	1	
22	..	..	1	3	..	..	..	..	..	4	
23	1	1	4	..	2	..	..	..	..	8	
24	..	1	2	1	1	1	..	1	..	7	
25	..	..	6	5	..	2	..	1	..	14	
26	..	1	3	3	1	..	2	1	..	11	
27	..	..	1	3	1	1	2	1	..	9	
28	..	..	..	1	2	..	..	1	..	4	
29	..	..	..	..	..	1	..	..	..	2	
30	..	..	..	..	..	1	1	1	..	2	
31	..	..	1	..	..	..	..	..	..	1	
32	..	..	..	1	..	..	..	..	..	1	
33	..	..	..	..	..	..	..	..	..	..	
34	..	..	..	..	..	..	..	1	1	2	
Total	1	3	20	17	7	6	5	7	1	67	
Average length ♂ and ♀	23.0	24.3	24.4	25.5	25.6	26.7	27.2	27.7	34.0		
— — ♂+♀	24.0		24.9		26.1		27.5		34.0		

Stat. 3519. — 20. Oct. 1925. — 55° 20′ N. Lat. 6° 45′ E. Long. Depth: 30 m. — Duration of fishing: ½ hr.

Age group	I	II		III		IV		V		VI		?		Total
Sex	♂	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂+♀
Length cm.														
14	1	..	..	..	..	..	..	..	..	..	..	..	..	1
15	..	1	..	..	..	..	..	..	..	..	..	..	..	1
16	..	8	6	12	..	..	..	..	..	..	..	..	..	26
17	..	11	5	11	7	..	..	..	..	..	..	..	..	34
18	..	7	4	24	9	..	..	..	..	..	..	..	..	44
19	..	4	2	19	12	..	..	..	..	..	..	..	1	38
20	..	5	2	21	5	4	..	..	..	..	..	..	..	37
21	..	4	1	10	9	2	7	..	2	..	..	..	..	35
22	..	1	2	17	10	6	4	4	..	..	..	1	..	45
23	..	..	..	10	6	8	4	2	..	1	..	..	..	31
24	..	..	1	1	4	3	1	5	2	2	..	..	..	19
25	..	..	..	3	..	6	2	1	3	..	1	..	..	16
26	..	..	..	..	..	1	1	2	4	..	..	..	..	8
27	..	..	..	..	..	..	2	3	2	..	..	..	..	7
28	..	..	..	..	..	..	1	..	..	..	..	..	..	1
29	..	..	..	..	..	..	..	..	..	..	..	..	..	..
30	..	..	..	..	..	..	..	1	..	..	..	..	..	2
Total	1	41	23	128	62	30	22	18	14	3	1	1	1	345
Average length ♂ and ♀	14.0	18.0	18.2	19.6	20.2	22.9	23.1	24.5	25.2	23.7	25.0	22.0	19.0	..
— — ♂+♀	14.0	18.1		19.8		23.0		24.8		24.0		20.5		..

Stat. 3702. — 28. March 1927. — 55° 28′ N. Lat. 8° 10′ E. Long. Depth: 10 m. — Duration of fishing: ½ hr.

Age group	0	I		II		III		IV		V		VI	Total caught
Sex	♂+♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♂+♀
Length cm.													
7	1	..	..	..	..	..	..	..	..	..	..	..	1
8	1	..	..	..	..	..	..	..	..	..	..	..	1
9	..	..	..	..	..	..	..	..	..	..	..	..	..
10	..	..	..	..	..	..	..	..	..	..	..	..	5
11	..	1	1	..	..	..	..	..	..	..	..	..	23
12	..	6	3	..	..	..	..	..	..	..	..	..	26
13	..	10	3	..	..	..	..	..	..	..	..	..	34
14	..	18	6	..	..	..	..	..	..	..	..	..	43
15	..	11	4	..	..	..	..	..	..	..	..	..	43
16	..	11	2	2	..	..	..	..	..	..	..	..	34
17	..	10	2	6	1	1	1	..	..	..	..	..	44
18	..	3	2	6	4	2	1	..	..	..	..	..	30
19	..	..	..	6	4	1	1	..	2	..	..	..	39
20	..	..	1	7	7	4	3	2	2	..	..	..	64
21	..	..	..	5	5	5	2	1	1	..	..	..	42
22	..	..	..	2	5	6	5	3	2	..	..	..	63
23	..	..	..	5	2	8	3	3	2	1	..	..	56
24	..	..	..	2	1	4	3	7	4	..	..	..	46
25	..	..	..	1	..	8	3	3	6	..	..	..	48
26	..	..	..	..	1	4	4	2	2	..	..	..	27
27	..	..	..	..	..	1	..	1	4	..	1	..	15
28	..	..	..	..	..	..	1	1	1	..	..	..	12
29	..	..	..	..	..	..	..	..	3	..	..	..	12
30	..	..	..	..	..	1	..	..	..	..	..	1	4
Total determined for Age	2	70	24	42	30	45	27	23	29	1	1	1	295
Total caught	5	168	58	101	72	108	65	55	70	2	2	2	712
Average length ♂ and ♀	..	14.7	14.7	19.8	20.5	22.9	22.7	23.7	24.5	23.0	27.0	30.0	
— — ♂+♀	7.5	14.7		20.1		22.8		24.1		25.0		30.0	

Stat. 3703. — 28. March 1927. — 55°29.8′ N. Lat. 8°2.3′ E. Long. — Depth: 30 m. — Duration of fishing: $^1/_2$ hr.

Age group	0	I		II	III		IV		Total
Sex	♂+♀	♂	♀	♂	♂	♀	♂	♀	♂+♀
Length cm.									
7	1	..	..	..	..	..	..	..	1
8	..	..	..	..	..	..	..	..	..
9	..	..	..	..	..	..	..	..	..
10	..	..	..	..	..	..	..	..	..
11	..	1	..	..	..	..	..	..	1
12	..	..	..	..	..	..	..	..	..
13	..	2	..	..	..	..	..	..	2
14	..	1	..	..	..	..	..	..	1
15	..	..	..	..	..	..	..	..	..
16	..	..	..	..	..	..	..	..	..
17	..	..	1	..	..	..	..	..	1
18	..	..	..	..	..	..	..	..	..
19	..	..	..	..	..	..	..	..	..
20	..	..	..	..	1	1	..	..	2
21	..	..	..	..	..	..	1	..	1
22	..	..	..	..	..	2	..	..	2
23	..	..	..	1	..	..	..	1	2
24	..	..	..	..	..	1	..	..	1
25	..	..	..	..	..	..	..	..	..
26	..	..	..	..	..	..	..	1	1
27	..	..	..	..	..	..	..	..	..
28	..	..	..	..	..	..	..	..	..
29	..	..	..	..	..	..	..	..	..
30	..	..	..	..	..	1	..	..	1
Total	1	4	1	1	1	5	1	2	16
Average length ♂ and ♀	..	12.8	17.0	23.0	20.0	23.6	21.0	24.5	
— — ♂+♀	7.0	13.6		23.0	22.0		23.3		

Stat. 3704[1]). — 29. March 1927. — 55°16′ N. Lat. 8°14′ E. Long. — Depth: 13 m. — Duration of fishing: $^1/_4$ hr.

Age group	0	I		II		III		IV		V	Total
Sex	♂+♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♂+♀
Length cm.											
7	1*	..	..	..	..	..	..	..	..	..	1
8	1*	..	..	..	..	..	..	..	..	..	1
9	..	..	..	..	..	..	..	..	..	..	..
10	..	2*	..	..	..	..	..	..	..	..	2
11	..	1+10*	3+11*	..	..	..	..	..	..	..	41
12	..	4+ 7*	5+ 3*	..	..	..	..	..	..	..	59
13	..	3*	2+ 1*	..	..	..	..	..	..	..	34
14	..	7+ 1*	5+ 3*	1	..	..	..	..	..	..	35
15	..	..	..	..	1	..	..	..	..	..	29
16	..	1	4	1	1	..	1	..	..	..	29
17	..	..	1	4	2	..	1	2	..	..	32
18	..	..	..	2	2	2	..	2	1	..	29
19	..	..	..	2	..	2	4	1	1	..	49
20	..	..	..	..	1	4	5	3	4	..	79
21	..	..	..	3	2	5	..	7	8	..	74
22	..	..	..	..	..	8	1	7	8	..	80
23	..	..	..	..	1	1	4	5	9	1	91
24	..	..	..	..	..	2	..	8	5	..	47
25	..	..	..	..	..	..	..	2	4	..	45
26	..	..	..	..	..	2	3	3	2	..	31
27	..	..	..	..	..	1	..	2	1	..	21
28	..	..	..	..	..	..	..	..	..	..	7
29	..	..	..	..	..	..	..	..	..	..	5
Total determined for Age	2*	13+23*	20+18*	13	10	23	19	42	43	1	188+43*
Total caught	3	78	103	55	42	115	81	178	183	4	798+43*
Average length ♂ and ♀	..	12.2	12.7	18.1	18.6	21.7	21.1	22.4	22.4	23.0	
— — ♂+♀	7.5	12.5		18.3		21.5		22.4		23.0	

[1]) The figures marked with an asterisk indicate plaice caugth in the extra cod-end.

Stat. 3705. — 29. March 1927. — 55° 16′ N. Lat. 7° 58′ E. Long. Depth: 18 m. — Duration of fishing: 1/4 hr.

1 Specimen. Age-group: IV. Sex: ♀. Length: 25 cm.

Stat. 3706. — 29. March 1927. — 55° 6′ N. Lat. 7° 58′ E. Long. Depth: 18 m. — Duration of fishing: 1/4 hr.

1 Specimen. Age group: VI. Sex: ♀. Length: 37 cm.

Stat. 3707. — 29. March 1927. — 55° 6′ N. Lat. 8° 14′ E. Long. Depth: 12 m: — Duration of fishing: 1/4 hr.

Age group	0	I		II		III		IV		V		VI		VII		Total
Sex	♂+♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂+♀
Length cm.																
6	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
9	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
11	..	3	..	..	..	..	..	..	..	..	..	..	..	..	..	3
12	..	1	1	..	1	..	..	..	..	..	..	..	..	..	..	3
13	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1
14	..	2	1	..	..	..	..	..	..	..	..	..	..	..	..	3
15	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	2
16	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1
17	..	..	1	..	..	..	..	1	..	..	..	..	..	..	..	2
18	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	2
19	..	1	..	..	1	..	..	..	1	..	..	..	..	..	..	3
20	..	..	..	1	..	..	..	..	1	..	..	..	..	..	..	2
21	..	..	..	..	..	2	1	3	1	..	..	..	..	..	..	7
22	..	..	..	..	..	..	1	8	2	..	..	..	..	..	..	11
23	..	..	..	..	..	..	..	2	2	..	..	..	..	..	..	4
24	..	..	..	..	..	1	1	6	5	..	..	..	..	..	..	13
25	..	..	..	..	..	..	2	2	3	1	1	1	..	..	..	10
26	..	..	..	1	..	..	..	6	2	2	..	..	..	..	..	11
27	..	..	..	..	..	1	2	4	2	2	2	..	1	2	..	16
28	..	..	..	..	..	1	..	2	2	2	3	..	..	..	..	10
29	..	..	..	..	..	1	..	..	1	1	1	1	..	..	..	5
30	..	..	..	..	..	..	1	1	1	1	1	..	2	..	..	7
31	..	..	..	..	..	..	..	..	..	..	3	..	..	..	..	3
32	..	..	..	..	..	..	..	..	1	..	..	1	1	..	..	3
33	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1
34	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
35	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
36	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Total	1	10	5	2	3	6	8	35	24	10	11	3	4	2	2	126
Average length ♂ and ♀	..	13.8	15.4	23.0	15.3	25.0	25.1	24.2	24.9	27.9	28.6	28.7	29.7	27.0	35.0	
— — ♂+♀..	6.0	14.3		18.4		25.1		24.5		28.3		29.3		31.0		

Dansk Resumé.

Materialet til den foretagne Undersøgelse stammer fra Fiskeforsøg med 50 Fods Ottertrawl fra Begyndelsen af April 1925, fra Oktober 1925 og fra Slutningen af Marts 1927 i det sydlige Hornsrevomraade udenfor 10 m Kurven.

Resultaterne fra disse Fiskeforsøg er, hvad Bestandens Sammensætning efter Størrelses og Aldersgrupper angaar, vist paa Kortene Fig. 1—4, pp. 5, 7, 8, 9 og Fig. 6—7 pp. 14, 15 og i Tabellerne 1—4, pp. 5, 6 og Tab. 12—13, pp. 15, 16, og Sammenligning er foretaget mellem Resultaterne fra disse Aar og med Resultaterne af Fiskeforsøg foretaget før Krigen og i September 1922.

Det fremgaar af denne Sammenligning, at Bestandens Individrigdom i det sydlige Hornsrevomraade udenfor 10 m Kurven har været omtrent den samme i 1925 og 1927 som i 1922, men at der i disse Aar er foregaaet en Forskydning i Bestandens Sammensætning i Retning af større og ældre Rødspætter.

Mens det i Efteraaret 1922 var Aldersgrupperne I og II (Aargangene 1920 og 1921), der dominerede i det betragtede Omraade, var det i Foraar og Efteraar 1925 samt i Foraaret 1927 II—V-Gr., der dominerede. Baade ved Fiskeforsøgene i 1925 og i 1927 viste Aargang 1922 de største Individantal (sml. Fig. 8, p. 21 og Fig. 9, p. 22). Da Individantallet udenfor 10 m. Kurven var omtrent ens de tre Aar, maa det totale Individantal i det sydlige Hornsrevomraade fra Kysten og udefter have været aftagende i disse Aar, idet Individrigdommen i de yngste Aldersgrupper, der har deres Hovedudbredelsesomraade mellem Kysten og 10 m Kurven, har været stadig aftagende.

Antallet af Rødspætter over 22,5 cm var i Efteraaret 1925 ca. 8 Gange større i det sydlige Hornsrevomraade udenfor 10 m Kurven end i Efteraaret 1922, og Antallet af disse Rødspætter var Foraaret 1927 dobbelt saa stort som i Foraaret 1925. Individantallet af de større Rødspætter var tiltaget endnu stærkere, navnlig fra 1922 til 1925.

En Undersøgelse af de forskellige Aarganges relative Hyppighed viste, at Aargangen 1922 i Aarrækken 1919—1926 har været den rigeste, men at ogsaa Aaret 1925 har ydet et meget betydeligt Antal Rødspætter. Aargangene 1919—1923 har alle været rige, Aaret 1921 har ydet mindre eller det samme Antal Rødspætter som i 1923. Aaret 1924 og, saavidt der paa det nuværende Tidspunkt kan dømmes derom, 1926 har givet de ringeste Aargange (sml. p. 27).

Ændringerne i Væksthastighed synes at have været bestemt af den aftagende totale Individrigdom, idet Gennemsnitslængden for de enkelte Aldersgrupper gennemgaaende øgedes fra 1922 til 1925 (Fig. 10, p. 31) og igen til 1927 (sml. Tabel 29, p. 32). En Sammenligning mellem Ændringerne i Individrigdommen i en Aldersgruppe mellem 1925 og 1927 og Forskellen mellem Rødspætternes Gennemsnitslængde i vedkommende Aldersgruppe de to Aar (Fig. 12, p. 33) viste, at Gennemsnitslængden af en Aargangs Rødspætter i betydelig Grad er bestemt af, hvor rig vedkommende Aargang har været. Desuden vistes (Fig. 13 og 14, p. 38) at for hver af Aldersgrupperne II—VI varierer Rødspætternes Gennemsnitslængde fra Station til Station om Efteraaret omvendt med Rødspætternes Tæthed paa vedkommende Station, naar Antallet af Rødspætter af vedkommende Aldersgruppe taget ved Fiskeforsøgene er saa stort, at Middellængden maa antages at være bestemt med tilstrækkelig Nøjagtighed. Dette maa forklares som et Resultat af Konkurrencen indenfor de enkelte Lokaliteters Rødspætter, og det maa i Betragtning af Størrelsen af Variationerne i Gennemsnitslængde antages, at Bestanden fundet paa en enkelt Lokalitet har bestaaet væsentlig af de samme Rødspætter Sommeren igennem.

En Undersøgelse af den relative Hyppighed af Hanner og Hunner viste, at denne, naar hele det betragtede Omraades Rødspættebestand ses under eet, ikke kan have undgaaet væsentlige Ændringer i disse Aar. Derimod er der vanskelig forklarlige Forskelligheder i den lokale Udbredelse af Hanners og Hunners relative Hyppighed de forskellige Aar.

En Undersøgelse af Tyngdepunktet eller Gennemsnitsdybden for Forekomst af de forskellige Aldersgruppers Rødspætter i det betragtede Omraade viste, at der ikke er sket større Ændringer, end at de naturligt kan forklares ud fra de forskellige Aldersgruppers forskellige Gennemsnitslængde i disse Aar.

Sammenligning er foretaget med Resultatet af Undersøgelser i de øvrige Omraader af den sydøstlige Nordsøs Opvækstgrunde. Hornsrevomraadet viser betydelig Lighed med Omraadet omkring Helgoland, mens der Vest herfor synes at have været andre Forhold tildels med Hensyn til Forholdet mellem de forskellige Aarganges Hyppighed, men særlig synes Vækstforholdene i Leman-Haaks Omraadet at have været forskellige fra de østlige Opvækstomraaders.

Den Hypotese er fremsat af W. Garstang, at den accumulerede Bestand af gamle Rødspætter i Nordsøen i de sidste Krigsaar og i Aarene straks efter Krigen ved Næringskonkurrencen trængte de smaa Rødspætter sammen paa Opvækstgrundene, hvor Sult og Død derfor herskede og at dette forklarede den ringe Mængde af smaa Rødspætter, der fandtes i den aabne Nordsø i Aarene 1919—1922.

I Hornsrevomraadet synes der imidlertid ikke i disse Aar at have været nogen Sammentrængning af de yngre Aldersgruppers Rødspætter paa Opvækstgrundene. Det er derfor undersøgt, om de Ændringer i de smaa Rødspætters Udbredelse i den aabne Nordsø, der er foregaaet efter Krigen, kan forklares ad andre Veje end ved Antagelse af, at de smaa Rødspætter efter Krigen var trængt sammen i et Omraade langs Kontinent Kysten. Det paapegedes, at a) den af Johansen paaviste Forbindelse mellem Vækthastighed og Fiskeriets Udbytte, b) Beliggenheden af Fiskegrundene for Trawlfiskeriet og c) de enkelte Aarganges relative Hyppighed tilsammen synes at kunne forklare de Ændringer, der under og efter Krigen er foregaaet i Handelskategorien Small's Hyppighed i de engelske Damptrawlerfangster.

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